CHILDREN'S USE OF LOGOGRAPHIC AND ALPHABETIC STRATEGIES IN LEARNING TO READ AND SPELL

By

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Twenty-four less skilled and more skilled readers from first through fourth grade were compared to determine if the children's reading and spelling strategies supported Frith's developmental model for reading and spelling at the logographic and alphabetic stages. The Battery of Linguistic Analysis of Writing and Reading - Children's Version (BLAWR-CV) was administered to assess the strategies which the children used to read and spell regular words, irregular words, ambiguous words and nonwords. Reading and spelling errors were analyzed to determine whether the subjects were using logographic and/or alphabetic strategies when reading and spelling single words. The Lindamood Auditory Conceptualization Test (LACT) also was administered to determine the relationship between phonological awareness and the ability to read/spell nonwords.

The results of this study indicated that both the less skilled and the more skilled readers relied on logographic and alphabetic strategies when reading and spelling. The difference between the groups was in the extent to which they relied on each of these strategies. In reading, the less skilled readers relied more heavily on a logographic strategy, whereas the more skilled readers relied primarily on an alphabetic strategy. In contrast, in spelling, both groups relied on an alphabetic strategy but, the more skilled readers were significantly more successful in applying this strategy. Overall, the more skilled readers used an alphabetic strategy more effectively and efficiently than the less skilled readers in both reading and spelling. These findings supported Frith's contention that alphabetic spelling precedes alphabetic reading.

Although there was a moderate positive correlation between LACT scores and the ability to read/spell nonwords, the total test scores on the LACT were not predictive of success for reading and spelling nonwords.

INTRODUCTION

Children master the use of spoken words long before they begin to read and spell words, and it is the spoken language system and the child's awareness of it that influences the acquisition of literacy. Snowling (1987) argues that the goal of literacy acquisition is to integrate a system for processing written language with the one that already exists for the processing of spoken words.

Learning to read and write depends to a large extent on the special language-related abilities that include, but necessarily go beyond, those required in the use of spoken language. Both written and oral language processing require phonological encoding of the message. For oral language, the ability to discriminate syllables and words is sufficient. But, to become competent in reading and spelling, children must acquire more explicit phonological awareness. Specifically, they must learn to analyze spoken words into phonemic units. Since the alphabet we employ represents the phonology, the child must have a conscious understanding of phonological segments in order to have a conceptual grasp of what the letters stand for.

Goswami and Bryant (1990) have suggested that children's awareness of intra-syllabic units (i.e., onset

and rime) which comes before learning to read affects their reading success. Children's awareness of onset and rime is linked with their skill in rhyme and alliteration. When children learn to speak they begin categorizing words based on initial sound similarities (e.g., "bʌ" for "bird" then "ball", "banana"). By preschool age, children can group words together that rhyme with each other. Through rhyming games, children learn to analyze words within the syllabic unit at the level of the phoneme and to categorize words which share a common sound. When children begin to read the ability to categorize words based on onset and rime facilitates an awareness that words in the same categories have similar spelling patterns (i.e., sequence of letters) and these patterns represent the common sound. Sensitivity to alliteration and rhyme allows children to make inferences about unfamiliar words based on the spelling patterns in words that they already know. Through reading experience children learn that rimes can be segmented into phonemes. Initially, knowledge of phonemes plays a small part in reading; however, it has an immediate effect on spelling. Bryant and Bradley (1985) have stated that children who experience difficulty learning about the relationship between letters and sounds and between groups of letters and sounds are bound to fall behind in learning to read and even further behind in learning to spell.

According to Kamhi and Catts (1989), there are several significant problems that face speakers, readers, and writers of English. The first problem centers on the fact that "phonemes are abstract linguistic concepts rather than physically real entities, and as such do not correspond to discrete and invariant sounds" (p. 28). For example, in conversational speech the sound segments of speech run together as a result of coarticulation. A second related problem is that each phoneme has several different phonetic variations. That is, phonemes differ acoustically and phonetically depending on the context in which they occur. These two problems combined make the task of learning grapheme-phoneme and phoneme-grapheme correspondence rules a formidable one. Confounding the problem even further are the irregularities of English orthography. There are 251 different spellings for the 44 sounds of English (Horn, 1926). It is not surprising then that some children experience difficulty in acquiring literacy.

The area of language processing that appears crucial to literacy acquisition is phonological processing. The aspect of phonological processing which has received the most attention is phonological awareness. When learning to read the child is faced with the task of constructing a link between the signs of print and the sounds of speech. In order to construct this link, the child must become aware that speech can be segmented into phonemes which are

represented more or less by the alphabet (Blachman, 1989). There are two conflicting hypotheses regarding the cause and effect relationship between phonological awareness and reading acquisition. One hypothesis suggests that reading acquisition is not only facilitated by phonological awareness but it is necessary for learning to read. Accordingly, children's success in reading is dependent on phonological skills which are acquired before they learn to read. The opposing hypothesis states that learning to read is a cause of phonological awareness. That is, children are able to segment words into their constituent sounds because they are trained to do so while learning how to read. A third possible hypothesis suggests that there is a reciprocal relationship between phonological awareness and reading acquisition. According to this view, phonological awareness is both a cause and a consequence of learning to read. Numerous studies now have shown that children who lack phonological awareness are "at risk" for becoming poor readers and spellers (Bradley & Bryant, 1985; Bryant & Bradley, 1985; Fox & Routh, 1975; Sawyer, 1988; Snowling & Perin, 1982; Treimen & Baron, 1981: Wagner & Torgesen, 1987). According to Stanovich (1986), "it is apparently important that the prerequisite phonological awareness and skill at spelling-to-sound mapping be in place early in the child's development because their absence can initiate a causal chain of escalating negative side effects" (p. 364).

In the past decade, research has focused on two processing strategies, a visual strategy and a phonological strategy, and the extent to which children rely on these two strategies in the process of learning to read and to write. In reading, the pronunciation of a word can be accessed directly from the mental lexicon based upon its visual representation using a visual strategy. Similarly, in spelling, the orthographic form of a word can be accessed directly out of memory storage. This strategy has been variously referred to as the direct, visual, look-say or whole word approach. The second strategy is phonological in nature and is based upon knowledge of the relationship between phonemes, as represented in oral language, and graphemes, as represented in written language. This strategy has been referred to as the indirect or phonological strategy. In reading, the child uses knowledge of grapheme-phoneme correspondence rules to form a phonological sequence that is then matched to a similar sequence in the mental lexicon. In spelling, the orthographic form of the word can be derived by application of phoneme-grapheme correspondence rules. In order to use a phonological strategy successfully, in either reading or spelling, the child must have explicit awareness of the phonological structure of words, and in particular, the knowledge that words consist of discrete phonemic segments (Treiman & Baron, 1981).

Consider, for example, how a child might read and/or spell the words bat and palace. If the words were familiar to the child they may have been stored in his mental lexicon and could be accessed directly via a direct or sight word approach. However, if the words were unfamiliar to the child he might attempt to apply grapheme-phoneme correspondence rules. If the child attempted to sound out the word BAT he would be successful in reading or spelling the word since there is a one-to-one letter and sound correspondence. However, he would be unsuccessful in sounding out the word PALACE since there is not a direct letter and sound correspondence. Without a phonological strategy children are unable to tackle new words or nonwords and without a visual strategy children are unable to read or spell familiar words automatically or irregular words (Stackhouse, 1989).

Frith (1985) has proposed a theoretical model to account for the development of the visual and phonological strategies in both reading and spelling. Frith's model of literacy acquisition consists of three stages: the logographic stage, the alphabetic stage, and the orthographic stage. In the logographic stage, a child can only read familiar words as he does not yet possess the phonological skills necessary to decipher unfamiliar, novel words. At this stage very few spelling attempts occur. However, children may use their knowledge of letter names to

construct simple words (e.g., da/day, fel/feel, mi/my, u/you). Advancement into the alphabetic stage requires that the child learn the relationship between letters and sounds. The alphabetic stage is marked by the acquisition of grapheme-phoneme and phoneme-grapheme correspondence rules. Once these rules are learned new words can be tackled. The ability to apply phoneme-grapheme correspondence rules facilitates the child's spelling development. By the end of the alphabetic stage, children can spell with complete phonetic accuracy; however, the alphabetic reader/speller does not have a mechanism for dealing with irregular or inconsistent orthographic patterns. A final transition is needed into the orthographic stage which occurs through an amalgamation of the logographic (visual) and alphabetic (phonological) strategies. At this final stage, reading and spelling are analytic yet independent of letter and sound correspondence. Words are analyzed based on morphemic units rather than visual properties such as shape or phonological correspondence rules. In reading, there is an automatic analysis of words into orthographic units (e.g., -tion, inter-, -over). In spelling, there is a shift from reliance on phoneme-grapheme correspondence to the use of word-based spelling patterns. At this stage, the previously learned strategies still remain accessible and will be useful in certain circumstances such as dealing with unfamiliar words and nonsense words.

The purpose of the current study was to investigate the development of reading and spelling in first through fourth grade children utilizing an experimental reading and spelling assessment instrument, the Battery of Linguistic Analysis of Writing and Reading - Children's Version (BLAWR-CV) (Roeltgen, 1987). Frith's (1985) model was used as the developmental framework for this reading and spelling battery. The BLAWR-CV consists of a series of individual subtests containing nonwords and real words (i.e., noun/function words, regular/irregular words, low/high ambiguous words, high/low imagery words, and homophones). The BLAWR-CV is appropriate for children reading and/or spelling at a first through fifth grade level. An analysis of the children's reading and spelling errors was developed, based on Frith's model, to determine whether the children were using logographic (visual) and/or alphabetic (phonological) strategies in their approach to reading and spelling. A test of auditory conceptualization was included to determine if there was a correlation between this measure of phonological awareness and the ability to use an alphabetic approach in reading and spelling nonwords.

LITERATURE REVIEW

The Role of Phoneme Awareness in Learning to Read and Spell

Phonological processing appears to be the primary aspect of language processing that is crucial to the acquisition of reading. According to Kamhi and Catts (1989), phonological processing "refers to various linguistic operations that make use of information about the speech sound (i.e., phonological) structure of the language" (p. 101). A number of investigators have suggested that deficits in phonological processing are related to the difficulties that some children have in acquiring and using written language (Bradley & Bryant, 1978; Bryant & Bradley, 1985; Frith, 1981; Jorm & Share, 1983; Wagner & Torgesen, 1987). Specifically, phonological processing deficits could impact on the acquisition and use of phonological and visual strategies. For example, for children with poor phonological awareness, the correspondence between a word's spelling and its pronunciation may appear arbitrary. These children often experience difficulty breaking the alphabetic code and learning the correspondences between graphemes and phonemes. Problems that interfere with the use of a phonological strategy also will affect the acquisition of a

sight word vocabulary, since building a sight word vocabulary depends not only on learning a new association but also on developing a new phonological representation (Catts, 1989).

Research on phonological processing and its relationship to reading and spelling has investigated (1) the encoding of phonological information in memory, (2) the storage and retrieval of phonological information, (3) the use of phonological codes in working memory, (4) phonological awareness, and (5) the production of phonological sequences. Of particular interest is the area of phonological awareness which involves the explicit knowledge about the sound structure of the language. Blachman (1989) has defined phonological awareness as "the awareness of, and ability to manipulate, the phonological segments in words--specifically, the phonemes represented in an alphabetic orthography" (p. 133).

Some researchers have suggested that phonological awareness may be a function of learning to read rather than something that is developed prior to learning to read (Alegria, Pignot & Morais, 1982; Ehri, 1987; Morais, Cary, Alegria & Bartelson, 1979; Read, Zhang, Nie & Ding, 1986). Read et al. (1986) investigated the ability of two groups of Chinese literate adults to add or delete phonemes from spoken syllables. They found that the group that was exposed to the alphabetic system (pinyin) in elementary

education was more competent in phoneme segmentation than the group who knew only the traditional logographic system. Similar results were found in 6- year old children in the study conducted by Alegria, et al (1982). In this study, two groups of children, one being taught by a phonics approach and the other by a "whole word" approach, were given a syllable and phoneme reversal task. The results indicated no differences between the two groups on the syllable task; however, they found a significant difference in the phoneme task. The "whole word" group performed more poorly on the phoneme task as compared to the phonics group. A conclusion which can be drawn from these different studies is that reading experience and instruction may in fact facilitate phonological awareness.

Although reading experience may enhance phonological awareness, there is also evidence to suggest that early sound awareness is a good predictor of later literacy (Bradley & Bryant, 1985; Bryant & Bradley, 1985; Fox & Routh, 1975; Sawyer, 1988; Snowling & Perin, 1982; Treiman & Baron, 1981; Wagner & Torgesen, 1987). The relationship between phonological awareness and reading/spelling success appears to be strong regardless of the task used to measure it. In addition, Bryant and Bradley (1985) have suggested that there may be individual differences in phonological awareness, from children who are rather insensitive to sounds to those who are extremely good at identifying

sounds. Accordingly, a child's place on a phonological awareness, might play an important role in determining whether he reads/spells as well as expected or better or worse.

In a longitudinal study conducted by Bradley and Bryant (1985), young children's sensitivity to sounds were investigated before they began to read. In this study, 4- and 5-year old children were given a series of rhyming and alliteration tasks. In the rhyming tasks, the children had to listen to either three or four words and identify which word did not rhyme. The position of the crucial sound in the words was varied for the tasks, sometimes it was at the end (e.g., bun, hut, gun, sun) and sometimes it was in the middle (e.g., hug, pig, dig, wig). In the case of the alliteration task the crucial sound was at the beginning (e.g., bud, bun, bus, rug). The investigators found that the alliteration task was significantly more difficult than the rhyming tasks. To account for this discrepancy, they suggested that children have more experience with rhymes in word games and nursery rhymes and therefore are better at them. At the conclusion of the study, they found that the scores on the initial rhyming tasks predicted reading and spelling progress over three years later; children who were better at rhyming were also better readers and spellers. Bradley and Bryant concluded that it is not only early skills but early experiences with speech sounds that have an

important and lasting effect in reading and spelling. In a different type of study, Treiman and Baron (1981) used a sound counting task to investigate phonological awareness in first and second grade children. The tasks consisted of a nonspeech counting task, a syllable counting task (1, 2 or 3 CV nonsense syllables), a phoneme counting task (nonsense syllables) and a nonsense word reading task. The children were asked to put down one, two or three checkers depending on the number of units they heard during the counting tasks. Results on the counting tasks were then compared to those found on the nonsense word reading task. Both groups of children experienced greater difficulty representing the spoken stimulus in terms of phonemes rather than in syllables. In addition, the children's ability to count phonemes correlated highly with an ability to read nonsense words. Treiman and Baron concluded that the ability to count phonemes relates specifically to the ability to use spelling-sound rules since these rules are used to read nonsense words. They further concluded that phonemic analyses may be more important than syllabic analyses in using spelling-sound rules.

Sawyer (1988) suggested that there is a developmental progression in the awareness of language units from words to syllables to sounds. In her longitudinal study, children in kindergarten and first grade were asked to use small wooden blocks to identify words, syllables or sounds. Sawyer found

that not only were children who were poor at phoneme segmentation at risk for reading acquisition, but also at risk were those children who lagged behind age mates in acquiring the earlier maturing word and syllable awareness. Sawyer speculated that evidence of a phonological processing disorder among poor readers may first be recognized as slower than typical progress toward mastery of word and syllable segmentation. She further suggested that a test of auditory segmentation be included in readiness tests for kindergarten and first graders and that the test include measures of segmenting performance at the word, syllable and phoneme levels.

The previous studies have focused on the causal relationship between phonological awareness and reading and spelling achievement. However, one longitudinal study conducted by Cataldo and Ellis (1988) has investigated the interactive development of reading, spelling and phonological awareness. Cataldo and Ellis followed 28 children through their first three years of school. The children were tested at four intervals in reading and spelling real and nonsense words, implicit phonological awareness (i.e., auditory categorization) and explicit phonological awareness (i.e., phoneme segmentation). Three phases of development were measured including: Phase 1 - the children's first year in school; Phase 2 - spring of the first school year to fall of the second school year; Phase

3 - beginning of the second school year to beginning of the third school year. They found that spelling was an important contributor to reading during Phase 1 and had an even stronger influence in Phase 2, whereas in both Phases 1 and 2 reading had a negligible influence on spelling. During Phase 1 implicit phonological awareness influenced early attempts to read and spell but its influence faded in Phases 2 and 3. Explicit phonological awareness, on the other hand, consistently predicted spelling during all three phases with increasing influence over time. And, only at Phase 3 did explicit phonological awareness contribute significantly to reading. The authors concluded that both implicit and explicit phonological awareness affect spelling development with explicit phonological awareness increasing its influence over time while the contribution of implicit awareness decreased over time. It was only later in the developmental sequence that explicit phonological awareness contributed directly to reading. According to Ellis (1991), "spelling affords the opportunity to forge a meaningful link between phonological awareness and letter-sound knowledge. This connection is a prerequisite to the development of phonological strategies in reading" (p. 88).

In summary, a number of studies have indicated that phonological awareness is related to reading and spelling ability. At the present time this relationship appears to be reciprocal in nature rather than causal. In some

instances, reading experience or instruction facilitates phonological awareness; in other instances, early phonological awareness positively effects reading and spelling achievement.

Relationships Between Reading and Spelling

Reading and spelling have complementary functions based upon common knowledge of the phonology and orthography of the language. Both skills are learned by children within approximately the same period of time. Although there are obvious parallels between reading and spelling, one is not the simple inverse of the other. Most adults know that their reading and spelling ability is not the same. At times, many adults and almost all children find themselves unable to spell a word which they can read with ease. And, Bryant and Bradley (1980) found that young children are able to spell words which they cannot read. This finding suggests that children initially learn to read and spell in different ways.

In their study, Bryant and Bradley (1980) suggested that children's reading initially depends heavily on visual chunks whereas their spelling relies on using phonological segments. To test this hypothesis, they devised three different experimental situations. In the first experiment, they gave two groups of children, a backward reading group (mean age 10 1/2 years) and normal readers (mean age 7 years), the same list of regular words to read on one

occasion and to spell on another. In both groups, they found that many of the children could read words they could not spell. However, in both groups, they also found that some children spelled words that they could not read. This particular finding did vary with the children's age and reading level. The higher the age and reading level of the children the less likely the children were to spell words and not to read them. An analysis of the mis-read and mis-spelled words revealed that the spelling errors had a phonological connection to the stimulus word. This finding indicated that the children were applying a phonological strategy when attempting to spell a word but not when they were reading a word.

In the second experiment, Bryant and Bradley included a wider variety of words (i.e., regular and irregular words) and asked 6 1/2-7 year olds and 7-7 3/4 year olds to read and spell the words. The results were consistent with those reported in the first study. In addition, all the words spelled correctly but not read correctly were regular words (e.g., bun, mat, leg, pot) which could be constructed on a letter-by-letter basis.

In the final experiment, nonwords were used as stimuli along with the regular and irregular words which the children were unable to read in the previous study. In this situation, the children were encouraged to read the words phonologically (i.e., sound the words out). These results

confirmed the results of the previous experiments. That is, the younger children often read and spelled the same words in different ways (i.e., they depended on visual chunks when they read and phonological segments when they spelled). However, these children could be persuaded to read words which they had previously spelled but misread by adopting a phonological strategy. The investigators hypothesized that if a child cannot construct a word phonetically he cannot read it phonetically either. However, as time goes on, children begin to read phonetically as well as visually and they use their memory of visual chunks to assist in spelling words (Bryant & Bradley, 1980).

Frith (1980) suggested that the difference between using a visual or phonological strategy is in the contrast between using partial and full cues. For word recognition, a partial analysis of the orthographic structure is often sufficient, as is demonstrated in speed reading techniques. However, in spelling, the full letter-by-letter sequence must be produced in order to write a word correctly. In order to be a good speller words must be represented in a detailed way in the mind and this memory image must be recoverable (Snowling, 1985).

Frith (1980) investigated differences in spelling abilities of 12 year old good readers/good spellers and good readers/poor spellers. Her conclusions were very similar to those reached by Bryant and Bradley (1980) for beginning

readers. Frith found that the good readers/good spellers and good readers/poor spellers achieved similar results on the Schonell Graded Word Reading Test but that the good readers/poor spellers made significantly more errors when asked to read nonwords. This finding revealed that the good readers/poor spellers were applying a visual strategy when reading. Since both groups were good readers, Frith hypothesized that a similar level of reading achievement can be obtained through qualitatively different strategies. In spelling, Frith found that the poor spellers were good at spelling nonwords but poor at spelling real words. The poor spellers relied on spelling words according to the way they sound rather than taking into account the correct letter sequence of the specific word; hence, they relied too heavily on phoneme-grapheme rules. A phonological strategy is often unsuccessful in spelling because of the seemingly "arbitrary" convention of English orthography. Frith concluded that the poor spellers were so good at reading by partial cues that they never attended to the letter-by-letter structure of the words.

Bryant and Bradley's (1980) and Frith's (1980) studies have demonstrated that reading and spelling are independent processes but their development is interdependent. Initially, knowledge gleaned from spelling contributes to reading. At the skilled level, however, it appears that

spelling is dependent on reading since accurate spelling relies on information derived through reading.

Dual Route Hypothesis in Reading and Spelling

In the past decade, research has focused on two strategies used by children learning to read and spell words. One is a phonological strategy which is based on a phonologic code (i.e., a form of internal representation used by the memory system to represent speech information) and is generated by applying spelling-to-sound or sound-to-spelling correspondence rules. To use this strategy the child must recognize that words and syllables can be broken down into phonetic units which correspond in various ways to alphabetic letters (Bryant & Bradley, 1980). The other strategy is visual and involves a direct visual-orthographic code (i.e., a form of internal representation used by the memory system to represent visual information). To utilize this strategy, the child must be able to recognize the orthographic cues inherent in words (i.e., the letter-by-letter structure of words) (Snowling & Frith, 1981).

These two strategies can be used in order to obtain access to information stored in the mental lexicon for both reading and spelling (Barron, 1980). In reading using a direct visual strategy, words can be recognized instantly without applying grapheme-phoneme correspondence rules. Instant recognition of familiar words involves more than the visual shape of a word alone. In a study investigating the

role of sound, shape and orthographic cues in early reading, Snowling and Frith (1981) demonstrated that in beginning readers what is instantly recognized is the identity and position of letters in the word and not merely the shape of the letters. The "look-say" teaching technique capitalizes on this strategy. In spelling, the orthographic form of the word can be accessed directly from memory storage utilizing a visual strategy.

The phonological strategy, on the other hand, requires full letter cues. In reading, individual graphemes are translated into phonemes and matched to a similar phonological sequence in memory storage prior to reading the word. In the early stages of reading the spelling-to-sound correspondence are treated as invariant and are processed from left to right in serial order (Marsh, et al., 1980). In spelling, the orthographic form of the word can be derived by application of phoneme-grapheme correspondence rules. This strategy is useful in spelling as well as in reading as long as the spelling-to-sound correspondence are reversible; however, spelling-to-sound correspondence are not always reversible in English (Gould, 1976). Due to the lack of correspondence between English spelling and pronunciation, this strategy is not normally employed by skilled readers (Coltheart, et al., 1977) but may be used when the letter strings to be read simply cannot be recognized because the word is not represented in the mental

lexicon (Frith, 1983). An important aspect of the phonological strategy is that its use focuses the child's attention on the specific patterns of letters in words. This allows the child's orthographic representations of words to become more elaborate, thus words become easier to identify directly (Kamhi & Catts, 1989).

Application of Visual and Phonological Strategies in Reading and Spelling

Both visual and phonological strategies appear to play important roles in the acquisition of reading and spelling skills. The knowledge and use of these strategies is assessed when the child is confronted with reading and/or spelling various types of words, including regular, irregular, and novel or nonsense words (i.e., made-up words consisting of orthographically legal strings of letters).

Regular words (e.g., cat, must, swim) conform to spelling rules and can be read or spelled by using either a visual strategy or a phonological strategy. Barron (1980) suggested that during reading "a phonological strategy could be used by applying spelling-to-sound rules to generate a phonological code which would correspond to a phonological entry in the lexicon. A visual-orthographic strategy could be used to generate a visual-orthographic code which would correspond to a visual-orthographic entry in the lexicon" (p. 196). Similarly, during spelling, a phonological strategy could be used to generate the spelling of a regular

word by applying sound-to-spelling correspondence rules. Or, a visual strategy could be used by retrieving information stored in the mental lexicon (Baron, 1980).

On the other hand, irregular words (e.g., knife, sword, laugh, yacht) are exceptions to spelling rules and cannot be read or spelled correctly by employing a phonological strategy. Application of a phonological strategy to an irregular word will result in a "regularization" error (e.g., brode/broad, yot/yacht, woch/watch). In order to read or spell irregular words successfully one must use a direct visual strategy.

In order to read or spell nonsense words (e.g., mebe, oyt, zang) rules of some kind must be used since these words are not stored in memory for direct access. The most obvious rules to use are grapheme-phoneme or phoneme-grapheme correspondence rules. However, it also may be possible to read/spell nonwords on the basis of analogies with the letter sequences found in other words. Although this still may be considered "phonological" it is a far cry from converting each letter into a sound (Marcel, 1980; Snowling, 1985).

Baron and his colleagues (Baron, 1979; Baron, Treiman, Wilf & Kellerman, 1980; Treiman & Baron, 1981; Treiman, 1984) have investigated differences in the strategies which normal children adopt for reading and spelling by asking them to read and spell various types of words. Two types of

readers and spellers were found, the "Phoenicians" and the "Chinese". In reading, the "Phoenicians" tended to rely heavily on spelling-sound correspondence rules; whereas, the "Chinese" read holistically and relied on word-specific associations. Similarly, the Chinese-Phoenician dimension can be applied to spelling (Treiman, 1984).

In a study investigating the reading strategies of normal first through fourth grade children, Baron (1979) administered a reading test comprised of three types of words: regular words (e.g., cloth, cut), exception words (e.g., garage, come), and nonsense words (e.g., lare, gome). Children described as "Phoenicians" were able to decode nonsense words relatively well but decoded exception words, which deviate from the rules, less well. Their errors on the exception words tended to reflect spelling-sound rules. In other words, exception words were pronounced like corresponding regular words (e.g., "give" pronounced as /gɒrv/ to rhyme with "hive"). Children described as "Chinese" read the nonsense words relatively poorly but read familiar words (regular or exception) relatively well. The results of this study suggested that at least children in first through fourth grade differ in their reliance on the two reading strategies, with some children preferring to rely on rules while others relied to a greater extent on word-specific associations.

Treiman (1984) examined spelling as well as reading strategies in normal third and fourth grade children using a spelling and reading test analogous to the one developed by Baron (1979). Results of the spelling test indicated that the children did best on regular words, followed by nonsense words and poorest on exception words. The fact that the third and fourth grade children spelled regular and nonsense words more accurately than exception words suggests that grapheme-phoneme rules aided performance on regular and nonsense words. There was also a tendency to spell exception words by analogy to regular words, again suggesting application of rules. Results of the reading test were similar to those found by Baron. Those children who performed well on nonsense words also performed well on regular words, suggesting application of rules. Likewise, those children who performed well on exception words also performed well on regular words, suggesting use of word-specific associations. Treiman concluded that rules appear to play a greater role in spelling, particularly in the early stages, than they do in reading. This conclusion has been supported in other investigations of the development of reading and spelling skills (Barron, 1980; Bradley & Bryant, 1979; Bryant & Bradley, 1980; Frith, 1979; 1980).

A number of other studies have used various types of real words and nonwords to examine the reading and spelling strategies used by good and poor readers (Backman, Bruck,

Hebert & Seidenberg, 1984; Bruck & Waters, 1988; Seidenberg, Bruck, Fornarolo & Backman, 1985; Waters, Bruck & Seidenberg, 1985). These studies have demonstrated that the ability to use spelling-sound information varies as a function of age and underlies good reading and spelling ability.

In a study investigating children's acquisition and use of spelling-sound knowledge, Backman et al. (1984) compared the word recognition skills of good readers from grades 2 through 4 with the word recognition skills of poor readers from grades 3 and 4. The children were asked to read a series of real words and nonwords containing regular (i.e., one pronunciation) and homographic (i.e., more than one pronunciation) spelling patterns. Words with homographic spelling patterns included exception words (e.g., have), regular inconsistent words (e.g., gave), and ambiguous words (e.g., -own). The results indicated that both groups made similar numbers of errors on regular words. However, the good readers in grades 2 and 3 and the poor readers in grades 3 and 4 produced more errors when reading words with homographic spelling patterns than when reading regular words. While the fourth grade good readers read each word type equally well, the authors concluded that "it is the ability to cope with homographic spelling patterns that distinguishes skilled and unskilled readers, rather than the ability to read unambiguous spelling patterns" (p. 129). An

analysis of the types of mispronunciations made on the exception words and regular inconsistent words revealed that the errors were consistent across each group. That is, the errors were systematic, involving knowledge of spelling-sound correspondences. However, for exception words, the Grade 2 and poor readers exhibited a lower proportion of regularizations than the Grades 3 and 4 good readers, suggesting a weaker knowledge of spelling-sound correspondences. Similar results were found for the nonwords indicating that with increasing age and ability children acquire increasing knowledge of spelling-sound correspondences. Based on their findings, the authors suggested that there are two complementary developments occurring in the process of learning to read. One, there is a developmental shift in the children's knowledge of spelling-sound rules as demonstrated by an increasing ability to read nonwords and an increasing number of regularization errors for words with homographic spelling patterns in the more skilled readers. At the same time, children are recognizing many more words based on visual information as demonstrated by the more skilled readers' ability to pronounce words with homographic spelling patterns significantly better than the less skilled younger and poor readers.

In a similar study, Waters et al. (1985) investigated the use of spelling-sound information in both reading and

spelling. In this study, third grade children were asked to read and spell single nonwords and five different types of words that differed in terms of their regularity for reading and spelling. The children were divided into three groups based on scores obtained on the Wide Range Achievement Test: (a) "good" - good readers, good spellers; (b) "mixed" - good readers, poor spellers; and (c) "poor" - poor readers, poor spellers. The children's mis-spellings were classified as phonetic or nonphonetic and orthographically legal or orthographically illegal. Their mispronunciations were examined to determine if they were systematic (phonological) or contained another type of pronunciation error (e.g., substitution or omission). The results of the spelling tasks indicated that the children in each group applied sound-spelling information in spelling but that the "mixed" and "poor" groups exhibited weaker knowledge of phoneme-grapheme correspondence rules than the "good" group. This was demonstrated by the fact that the "mixed" and "poor" groups made more errors spelling nonwords and made fewer phonetic mis-spellings than the "good" group. The results were similar on the reading tasks. The "good" group exhibited better knowledge of spelling-sound correspondences than the "mixed" and "poor" groups as demonstrated by their ability to read nonwords. The authors concluded that the three groups of third grade children used spelling-sound information for both reading and spelling but that the

"good" group had a stronger knowledge of correspondence rules than the "mixed" and "poor" groups.

Marsh and his colleagues (Marsh, Desberg & Cooper, 1977; Marsh, Friedman, Welch & Desberg, 1980) have found that there is a developmental shift in the application of spelling-sound knowledge when reading and spelling single words. In a study investigating the developmental changes in reading strategies, Marsh et al. (1977) asked older subjects (i.e., grade 5, grade 11, college) to read 10 nonwords. The nonwords were constructed so that they could be read either by applying grapheme-phoneme correspondence rules or by analogy to a real word (e.g., puscle, risten). Following each response the subjects were probed for knowledge of analogue word. The results indicated that analogue responses increased with age/grade. The fifth grade subjects' dominant strategy was a grapheme-phoneme rules strategy while the college age subjects' dominant strategy was an analogy strategy. One factor was suggested that may produce this developmental change; that is, the accessibility of an appropriate analogue. Since younger readers have a limited lexicon stored in memory they may tend to rely on a grapheme-phoneme correspondence strategy; older readers may search for a related word in the mental lexicon and pronounce the unknown word by analogy to the spelling pattern of the known word.

To determine if there were similar developmental changes in spelling, Marsh et al. (1980) asked second and fifth grade students to spell a series of nonwords. They found that there was a significant difference between the second and fifth graders' use of a sequential encoding strategy (i.e., phonological strategy) and a hierarchical encoding strategy (i.e., rule-based strategy). The fifth grade children were superior to the second grade children when spelling simple CVC patterns, long vowel CVCe word patterns and C-rule nonwords. However, the second grade children's ability to spell CVC patterns and C-rule nonwords was superior to their spelling of CVCe patterns, suggesting emerging development of sequential encoding and hierarchical encoding strategies. A developmental shift also was noted in the use of an analogy strategy. The second graders' use of an analogy strategy was practically nonexistent whereas by fifth grade up to one-third of the responses were analogies. As in the reading study, Marsh et al. (1980) suggested that young children's failure to apply an analogy strategy may be because "...they do not as yet have a sufficient store of visual word forms in memory to use the strategy productively" (p. 344). The authors concluded that, as in reading, there is an age/grade developmental shift in the use of spelling strategies.

In summary, the use of regular words, irregular words, and nonwords has been useful in identifying the type of

strategy which children use to read and spell single words. The notion of a Phoenician-Chinese continuum has highlighted individual differences in the reliance on a phonological strategy as opposed to a visual strategy in both reading and spelling. It also has been demonstrated that children who differ in their reading achievement also differ in their ability to apply a phonological strategy in both reading and spelling. In addition, it appears that a phonological strategy plays a greater role in spelling than in reading, at least in the initial states of development.

A Model of Reading and Spelling Development

Several theories of reading and spelling development have been proposed in recent years (Chall, 1983; Ehri, 1987; Frith, 1985; Marsh & Desberg, 1983). Each of these theories provides a developmental stage model of literacy acquisition which follow a similar progression. A brief overview of the parallels between these models follows.

Chall (1983) has described a pre-reading and pre-writing stage beginning from birth. Within this stage children acquire an awareness and knowledge of the purposes and conventions of print. They learn what print looks like, where it is found, how to write their names, the names of the alphabet letters and so forth. Marking the end of the pre-reading and pre-writing stage is Frith's (1985) logographic or whole-word stage. At this stage, children rely on a whole-word strategy to read words since they are

insensitive to letter order and phoneme-grapheme correspondence. At this stage spelling is rudimentary but according to Ehri (1987) some semi-phonetic skills may be emerging. Phoneme awareness allows a transition into Frith's alphabetic stage which accommodates Marsh and Desberg's (1983) sequential and hierarchical decoding/ encoding stages, Chall's initial reading or decoding stage, and Ehri's phonetic strategies stage. The hallmark of this stage is the learning of phoneme-grapheme correspondence rules. Finally, during Frith's orthographic stage, children gain increasingly sophisticated knowledge of orthographic regularities and they are able to recognize words on the basis of orthographic patterns. At this stage, Marsh and Desberg describe the emergence and use of analogy strategies and Ehri describes the use of morphemic strategies for reading and spelling. According to Chall, children now read well enough to comprehend more difficult material and begin "reading to learn". Although each of the models provide a developmental sequence for literacy acquisition, Frith's model was designed specifically to account for the development of the visual and phonological strategies in both reading and spelling. Her model will be described in detail since it provided the framework for the experimental test battery used for this study.

Frith has proposed that there are three stages which the child passes through during the acquisition of literacy:

the logographic, the alphabetic, and the orthographic. According to Frith, the stages occur in sequential order with each new stage presumably capitalizing on the earlier one(s). However, transition through the three phases does not occur simultaneously for reading and spelling.

During the initial logographic phase, children read single words in a nonanalytic fashion based on salient visual properties of the word such as word shape or the presence of particular graphic features. Words that appear visually similar may be confused since the child is not yet aware of the importance of letter order or printed words (Snowling, 1985). Logographic readers can only read familiar words since they do not have the skills to decode unfamiliar, novel words. According to Marsh, et al (1980), visual reading is not conducive to spelling. Accordingly, at the logographic stage, spelling is crude. Very few spelling attempts are made with the exception of several highly familiar words or a single letter corresponding to a salient sound in the attempted word.

In the alphabetic stage, children acquire the knowledge and use of grapheme-phoneme and phoneme-grapheme correspondence rules. In order for the child to make the transition from the logographic stage to the alphabetic stage it is necessary for the child to reach a state of "phoneme awareness". Snowling (1985) states that at this stage "a child must understand that spoken words can be

segmented into phonemes" (p. 81). Other skills such as sound segmentation, auditory sequencing, phonological memory and phonological assembly are also necessary for passage into the alphabet stage (Snowling, 1985).

According to Frith, children enter the alphabetic stage first for spelling and then subsequently transfer letter-to-sound correspondence rules to reading. During this stage, rules of English orthography (e.g., silent "e" rule) are learned. The alphabetic strategy enables the child to pronounce and spell, although not always correctly, novel and nonsense words (Frith, 1985). As discussed previously, an alphabetic reader/speller would experience difficulty with irregular and/or inconsistent orthographic patterns as seen in the tendency to "regularize" irregular words. For example, island may be pronounced as /ɪslænd/ or yacht spelled as yot, each being phonetic but illegal. The ability to use orthographic analysis is acquired in a final stage referred to as the orthographic stage.

At the orthographic stage the child reads words via analysis of their orthographic structure or units (e.g., -tion, -cian, -ove) without an intermediate phonologic conversion. The orthographic stage differs from the logographic in that words are analyzed in a systematic way in terms of abstract orthographic properties, not on salient visual properties (e.g., shape of word) (Frith, 1985). It differs from the alphabetic stage in that words are

recognized directly from orthographic analysis rather than an intervening letter-by-letter decoding process. Frith maintains that children first enter the orthographic stage for reading and later for spelling.

The orthographic stage is the final stage in Frith's model. It is at this stage that children acquire an "analogy" strategy that is used to decode unfamiliar words. Rather than decoding an unfamiliar word by applying grapheme-phoneme correspondence rules children learn to search their internal lexicon for an analogue word and then pronounce the unfamiliar word by analogy to the known word. For example, faugh can be read as [fɔ] by decoding or [fæf] by analogy to laugh (Marsh, Friedman, Welch & Desberg, 1980). In spelling there is also a shift from a phonemic encoding strategy to the use of word-based or analogy spelling patterns (e.g., muscle - muscular) (Marsh, Friedman, Welch & Desberg, 1980; Snowling, 1987). Snowling (1987) has suggested that exposure to printed words (i.e., reading) is essential if the final phase of spelling is to be achieved.

In summary, Frith's model proposes an ordered sequence of stages for reading and spelling development. At the logographic stage, reading appears to be the pacemaker for spelling while the alphabetic stage is entered first for spelling and subsequently the skills are transferred to reading. At the orthographic stage spelling appears to be

dependent on reading. According to Frith, a child may be at one stage of development for reading and another for spelling. For example, a child may be at the logographic stage in reading and the alphabetic stage in spelling. Further, advancement into a subsequent stage does not preclude applying an earlier acquired strategy when necessary. In addition, children may be able to access a more advanced strategy when prompted to do so (Bryant & Bradley, 1980). Similarly, if a child has a problem with one stage of development it will affect the acquisition of subsequent stages as well.

Statement of Purpose

Previous research has shown that visual and phonological strategies play important roles in the acquisition of reading and spelling skills. However, the inter-relationship between these strategies in reading and spelling has not been fully explored. Fortunately, Frith's (1985) model of reading and spelling acquisition and Roeltgen's (1987) Battery of Linguistic Analysis of Writing and Reading - Children's Version (BLAWR-CV) provide a framework for investigating the inter-relationship of logographic and alphabetic strategies in reading and spelling.

Frith (1985) has proposed a developmental stage model of literacy acquisition which delineates the interactive developmental relationships between logographic (visual) and

alphabetic (phonological) strategies in reading and spelling. Frith contends that logographic and alphabetic strategies emerge at different times in reading and spelling. During the logographic stage, reading is the pacemaker for spelling, while the alphabetic stage is entered first for spelling and subsequently these skills are transferred to reading. At the orthographic stage, reading experience facilitates skilled spelling development. An important consideration of Frith's model is that one strategy does not replace another during the developmental process; rather, the progression through the stages is additive. For example, by the time children reach the orthographic stage they theoretically have both a logographic and an alphabetic strategy at their disposal.

Roeltgen (1987) has developed an experimental test battery, the Battery of Linguistic Analysis of Writing and Reading - Children's Version (BLAWR-CV), based on Frith's theoretical model to assess children's reading and spelling development. As mentioned previously, the BLAWR-CV is appropriate for children reading and/or spelling at a first through fifth grade level. The BLAWR-CV consists of a series of individual subtests containing nonwords and real words (i.e., noun/function words, regular/irregular words, low/high ambiguous words, high/low imagery words, and homophones). Previous research (Backman, Bruck, Hebert & Seidenberg, 1984; Baron, 1979; Treiman, 1984; Waters, Bruck

& Seidenberg, 1985) has demonstrated that it is important to incorporate words of various word types (e.g., regular words, irregular words, nonwords) in order to investigate the strategies used in reading and spelling single words.

A necessary component of the BLAWR-CV is an analysis of the reading and spelling errors to determine the strategy used to read or spell the target word. Unfortunately, an error analysis scheme was not included in the experimental version of the BLAWR-CV. Nelson (1980) has suggested several factors to consider when designing an error analysis classification system. First, the error word should be treated as single whole unit rather than as a number of separate errors. Also, each error type should be uniquely defined and mutually exclusive. Finally, the number of error categories should be limited. The strategy classification scheme used in this study was developed based on a review of the literature of other error classification systems and Frith's model of literacy acquisition. The strategy classification scheme was then employed to determine whether children were using a logographic or an alphabetic approach in reading and spelling words.

In order to use an alphabetic strategy effectively in reading or spelling it is necessary to have explicit awareness of the sound structure of the language. According to Snowling (1985), "in order to spell alphabetically, the child needs to be able to segment the sound stream and to

memorize and sequence sound segments" (p. 83). In order to transfer alphabetic knowledge to reading, "the child must know letter-sound relationships and be able to blend or assemble sound segments to synthesize whole words" (p. 83) (Snowling, 1985). If phoneme segmentation plays a role in the ability to use spelling-sound rules there should be a strong correlation between the ability to read/spell nonwords and measures of phoneme segmentation. One study by Treiman and Baron (1981) found that phonemic analysis played an important role in the ability to use spelling-sound rules in reading nonwords. However, the results were based on a phoneme counting task and the effect of phonemic analysis on the spelling of nonwords was not investigated. In this study, the Lindamood Auditory Conceptualization Test (LACT) (Lindamood & Lindamood, 1979) was used to investigate the relationship between phoneme segmentation and the ability to read and spell nonwords.

The purpose of this study was twofold. The first purpose was to investigate the use of logographic and alphabetic strategies in reading and spelling in normal less skilled (i.e., below a third grade reading level) and more skilled (i.e., at ot above a third grade reading level) readers in first through fourth grade to provide empirical support for Frith's contention that alphabetic spelling precedes alphabetic reading. The second purpose was to investigate the relationship between a measure of

phonological awareness, the LACT, and the ability to read and spell nonwords.

The following experimental questions were proposed:

1a. Are there significant differences in the type of strategy used by less skilled readers (< grade 3) and more skilled readers (≥ grade 3) when reading real words and nonwords?

1b. Are there significant differences in the type of strategy used by less skilled readers (< grade 3) and more skilled readers (≥ grade 3) when spelling real words and nonwords?

2a. How do reading scores on the BLAWR-CV (based on percentage correct) correlate across the three word types (regular words, irregular words, and nonwords) for the less skilled readers (< grade 3)?

2b. How do the reading scores on the BLAWR-CV (based on percentage correct) correlate across the three words types (regular words, irregular words, and nonwords) for the more skilled readers (≥ grade 3)?

2c. How do reading scores on the BLAWR-CV (based on percentage correct) compare across the three word types (regular words, irregular words, and nonwords) for less skilled (< grade 3) and more skilled (≥ grade 3) readers?

2d. How do spelling scores on the BLAWR-CV (based on percentage correct) correlate across the four word types (regular words, irregular words, ambiguous words, and nonwords) for the less skilled readers (< grade 3)?

2e. How do spelling scores on the BLAWR-CV (based on percentage correct) correlate across the four words types (regular words, irregular words, ambiguous words, and nonwords) for the more skilled readers (≥ grade 3)?

2f. How do spelling scores on the BLAWR-CV (based on percentage correct) compare across the four word types (regular words, irregular words, ambiguous words, and nonwords) for less skilled (< grade 3) and more skilled (≥ grade 3) readers?

3a. How do the total test scores on the LACT correlate with the ability to read nonwords for less skilled (< grade 3) and more skilled (≥ grade 3) readers?

3b. How do the test scores on the LACT correlate with the ability to spell nonwords for less skilled (< grade 3) and more skilled (≥ grade 3) readers?

The following hypotheses were tested:

1a. In reading, a logographic strategy will predominate in the less skilled readers (< grade 3) and an alphabetic strategy will predominate in the more skilled readers (≥ grade 3).

1b. In spelling, an alphabetic strategy will predominate in both the less skilled (< grade 3) and more skilled (≥ grade 3) readers.

2a. For the three reading word types (regular words, irregular words, and nonwords) higher correlations will be found between irregular words and regular words than between irregular words and nonwords for the less skilled readers (< grade 3).

2b. For the three reading word types (regular words, irregular words, and nonwords) higher correlations will be found between regular words and nonwords than between irregular words and nonwords for the more skilled readers (> grade 3).

2c. The less skilled readers (< grade 3) will perform more poorly when reading each of the word types (regular words, irregular words, and nonwords) as compared to the more skilled readers (≥ grade 3).

2d. For the four spelling word types (regular words, irregular words, ambiguous words, and nonwords) high correlations will be found between regular words and nonwords than between either irregular words or ambiguous words and nonwords for less skilled readers (< grade 3).

2e. For the four spelling word types (regular words, irregular words, ambiguous words, and nonwords) higher correlations will be found between regular

words and nonwords than between either irregular words or ambiguous words and nonwords for more skilled readers (≥ grade 3).

2f. The less skilled readers (< grade 3) will perform more poorly when spelling each of the word types (regular words, irregular words, ambiguous words, and nonwords) compared to the more skilled readers (≥ grade 3).

3a. For reading, a high positive correlation will be found between the subjects' ability to read nonwords and total test scores on the LACT.

3b. For spelling, a high positive correlation will be found between the subjects' ability to read nonwords and the total test scores on the LACT.

METHODS

The present study was an investigation of reading and spelling development in first through fourth grade children utilizing an experimental reading and spelling assessment instrument, the Battery of Linguistics Analysis of Writing and Reading - Children's Version (Roeltgen, 1987). The investigator analyzed the reading and spelling errors of 24 subjects to determine whether the subjects were using logographic (visual) and/or alphabetic (phonologic) strategies in their approach to reading and spelling single words. In addition, a test of auditory conceptualization was used to determine if a relationship exists between the subjects' performance on this test and their ability to use an alphabetic approach in the reading and/or spelling of single words.

Subjects

Twenty-four subjects were selected from the population of first through fourth grade children enrolled at Kimball Wiles Elementary School in the Alachua County school system. Of these twenty-four subjects, seven were selected from grade one, five from grade two, four from grade three and eight from grade four. The subjects ranged in age from 6

years, 3 months to 10 years, 7 month. Fifteen of the subjects were females and nine were males (see Appendix A). All of the subjects were chosen from regular classroom settings. Children assigned to Chapter 1 classrooms or to part-time Exceptional Student Education programs (e.g., severely learning disabled, emotionally handicapped, speech/language impaired, etc.) were excluded from the study. All of the children were receiving reading instruction through the Ginn Reading Series which combines both a sight-word and a phonics approach. Each subject initially chosen by the investigator to participate in the study was screened for vision and hearing prior to administration of the test battery. The vision screening was conducted by the school's nurse using a Snellen eye chart. Screened visual acuity of 20/30 or better, in both eyes, was considered to be within normal limits based on Alachua County Public School guidelines. Hearing screenings were conducted by the investigator using a calibrated Beltone 119 portable audiometer at 20 dBHL for the frequencies of 500, 1000, 2000 and 4000 Hz. Based on Alachua County Public School guidelines, screened hearing levels were considered to be within normal limits if a subject responded at 20 dBHL for all frequencies tested, bilaterally. Only those subjects who passed both the vision and hearing screenings were included in the study.

Parents of first through fourth grade students were contacted initially in person, at the school, or by telephone. Parents were interviewed regarding their child's developmental history and a brief description of the study was presented to them. Children with reported gross sensory, emotional or neurological handicaps were not considered for the study. Parents who agreed to allow their children to participate in the study were sent an informed consent form which was returned to the child's classroom teacher upon completion (see Appendix B).

Testing Stimuli

The following tests were chosen to assess aspects of phonological awareness and the ability to read and spell single words: (1) the Wide Range Achievement Test - Revised (WRAT-R) (Jastak & Wilkinson, 1984); (2) the Lindamood Auditory Conceptualization Test (LACT) (Lindamood & Lindamood, 1971), and; (3) the Battery of Linguistic Analysis for Writing and Reading - Children's Version (BLAWR-CV) (Roeltgen, 1987) and/or the Battery of Linguistic Analysis for Writing and Reading - Adult Version (BLAWR-AV) (Roeltgen, 1985).

The WRAT-R is a widely used achievement test designed to determine the grade level reading and spelling ability of children based on their ability to read and spell a series of single words. In this study, the reading and spelling grade levels obtained from the WRAT-R were used to determine

the level at which to begin testing on the BLAWR-CV and BLAWR-AV. The LACT was included in the test battery to assess two components of phonological awareness, a) the ability to discriminate one speech sound from another and, b) the ability to perceive the number and order of sounds within a spoken pattern. According to Lindamood and Lindamood (1971), the two test categories on the LACT, isolated sounds in sequence and sounds within syllable pattern, parallel two skills basic to reading and spelling, the conceptualization of isolated phonemic units and the conceptualization of contrasts within and between syllables with respect to identity and sequence. The BLAWR-CV was used to assess a child's ability to read and spell single real words of various word types (i.e., regular, irregular, and ambiguous words) and nonwords. The word lists on the BLAWR-CV are arranged hierarchically from first through fifth grade reading and spelling levels. The BLAWR-AV was used, as necessary, when a child's reading and/or spelling level was at or above a fifth grade level. The theoretical framework for the BLAWR-CV was based upon Frith's (1985) developmental model of literacy acquisition.

The order of presentation for the three tasks was the same for each child. The WRAT-R was administered first, followed by the LACT and then the BLAWR-CV and/or the BLAWR-AV (when necessary). A description of each of the tasks is presented below.

Task 1: Wide Range Achievement Test

The reading and spelling subtests of the Wide Range Achievement Test - Revised (WRAT-R) (Jastak & Wilkinson, 1984) were administered to assess the grade level reading and spelling abilities of each subject. The reading subtest consists of the following areas: at the pre-reading level - recognizing and naming letters, and; at the reading level - pronouncing words out of context. The spelling subtest consists of three parts: copying marks resembling letters, writing the subject's name, and writing single words to dictation.

Task 2: Lindamood Auditory Conceptualization Test

The Lindamood Auditory Conceptualization Test (LACT) (Lindamood & Lindamood, 1971) was administered to assess each subject's ability to discriminate one speech sound from another and to perceive the number and order of sounds within a spoken pattern. The Precheck tests the individuals knowledge of the following concepts: 1) sameness and difference; 2) number concept to four; 3) left to right order, and; 4) first/last concept. Following successful completion of the Precheck, the remaining two categories of the test were administered to the subject. In Category I, Isolated Sounds in Sequence, the subject must discriminate how many sounds he heard, whether the sounds were the same or different and the order of the sounds. In Category II, Sounds within Syllable Pattern, the subject must represent

changes which occur in syllable patterns as single sounds are added, substituted, omitted, shifted or repeated.

Task 3: Battery of Linguistic Analysis for Writing and Reading - Children's Version and Battery of Linguistic Analysis for Writing and Reading - Adult Version

The Battery of Linguistic Analysis for Writing and Reading - Children's Version (BLAWR-CV) (Roeltgen, 1987) assesses an individual's ability to read and spell single real words and nonwords. The BLAWR-CV consists of a series of individual subtests containing nonwords and real words. The subtests which comprise the BLAWR-CV include: Subtest I - Common/Less Common Single Phonemes; Subtest II - Nonwords; Subtest III - Noun/Function Words; Subtest IV - High/Low Imagery Words; Subtest V - Regular/Irregular Words; Subtest VI - Low/High Ambiguous Words, and; Subtest VII - Homophones.

Three BLAWR-CV subtests were administered in this study: regular/irregular words, low/high ambiguous words, and nonwords. Each subtest, with the exception of the Low/High Ambiguous Words Subtest, was used to assess the subjects' oral reading and written spelling abilities. The Low/High Ambiguous Words Subtest was used to assess the subjects' written spelling ability only since these words are not ambiguous for reading. The rationale for selecting these three subtests was based on discussions with David Roeltgen, M.D. concerning the purpose of this study and a review of the developmental reading and spelling literature.

The nonword, regular/irregular and ambiguous words subtests were selected as they were the most relevant for the purpose of this study since the reading and/or spelling of these word types reflect the use of a phonological or visual strategy. Following is a brief description of the content of each BLAWR-CV and BLAWR-AV subtest used in this study.

The Nonword Subtest is comprised of nine independent lists of nonwords ranging in length from two phonemes to four syllables (e.g., ep, skerm, lertkib, glunmekfublam). The nonword subtests are varied for phonetic complexity and long or short vowel forms.

The Regular/Irregular Words Subtest consists of six lists of regular/irregular words which are matched for length (phonemes, morphemes, and syllables), imageability, word class (all are nouns), frequency of occurrence and general age of acquisition (Roeltgen, 1987). A word is considered to be regular if it can be read and spelled by an algorhythmic (letter-by-letter) method (e.g., went, must, sleep, telephone).

The Low/High Ambiguous Words Subtest is comprised of four lists of words of varying ambiguity which are matched for length (phoneme, morpheme, and syllable), imageability, frequency of occurrence, and orthographic regularity. A word is considered to be of low ambiguity if there is only one acceptable spelling that produces the correct phonology (e.g., charm). A word is considered to be of high ambiguity

if more than one graphemic sequence can account for the morphemic sequence (e.g., cotton may be spelled cotton, kotton or cotten) (Roeltgen, 1987).

Each of the real word lists contain twenty words which are arranged in two groups of ten words each based on word type (i.e., regular and irregular words; low and high ambiguous words). For each regular/irregular word list there are ten regular and ten irregular words per list. Similarly, each low/high ambiguous word list consists of ten low and ten high ambiguous words per list. The four to six lists of regular/irregular words and low/high ambiguous words are arranged hierarchically with increasing difficulty. Difficulty is defined as 1) decreasing frequency of occurrence, 2) increasing length (i.e., number of letters and syllables), 3) later age of acquisition, and 4) increasing orthographic irregularity for words that are not in the regular/irregular group (i.e., nonwords and ambiguous words) (Roeltgen, 1987).

The Battery of Linguistic Analysis for Writing and Reading - Adult Version (BLAWR-AV) (Roeltgen, 1985) also assesses an individual's ability to read and spell single real words and nonwords. The individual tests on the BLAWR-AV correspond to those on the BLAWR-CV but are more suitable for those individuals reading and/or spelling at a fifth grade or higher level. Those subjects who read or spelled greater than fifty percent of the words on the most

difficult list of a particular word type on the BLAWR-CV were given corresponding subtests on the BLAWR-AV.

The Nonword Subtest of the BLAWR-AV, is comprised of four independent nonword lists which contain 10 one syllable and 10 two-syllable nonwords in each list. The nonword lists are approximately equal in phonemic complexity and orthographic complexity (Roeltgen, 1985).

The real word subtests on the BLAWR-AV consist of matched series of real words. The Regular/Irregular Words Subtest consists of three lists of regular and irregular words. There are two lists with 20 regular and 20 irregular words and one list with 10 regular and 10 irregular words. The regular/irregular words are matched for length (i.e., number of letters and syllables), imageability, frequency of occurrence, and word class (i.e., all are nouns) (Roeltgen, 1985). The three regular/irregular word lists are of graded difficulty with List 1 being "easiest" and List 3 the "hardest". Finally, on the Ambiguous Words Subtest there are two lists of ambiguous words. The first list consists of 10 words of low ambiguity (i.e., only one acceptable spelling to produce the correct phonology), 10 words of medium ambiguity (i.e., one phonetic sequence may be represented by more than one letter combination), and 10 words of high ambiguity (i.e., two or more phonetic sequences may be represented by more than one letter combination). The second list consists of 10 words of low

ambiguity, 10 words of medium ambiguity, 10 words of high ambiguity, and 10 words of very high ambiguity (i.e., three or more phonetic sequences may be represented by more than one letter combination). The words of varying ambiguity on each list are matched for number of letters and syllables, word class (i.e., all are nouns), frequency of occurrence, and imageability (Roeltgen, 1985).

Experimental Procedures

Testing sessions were scheduled at the subjects' school after the parental informed consent form was returned. Twenty subjects completed the testing in a single session which lasted approximately two hours. Four subjects required an additional session for various reasons (e.g., fatigue, transportation difficulties). These sessions always occurred within one week of the first session. Each subject was tested individually in a quiet room. The order of administration of the specific tasks was the same for all subjects. However, the order of administration for each subtest on the BLAWR-CV and BLAWR-AV was counter-balanced with the reading and spelling subtests given alternately. Varying the order of administration of the subtests helped to decrease both the learning effect which may occur if the subtests are given consecutively and the monotony of the task for both the subject and the examiner (Roeltgen, 1987).

Reading and Spelling Assessment

The reading and spelling subtests of the WRAT-R were administered in the usual standardized manner as were the Precheck and Category I and II tests of the LACT. The reading and spelling grade level results on the WRAT-R were used to designate the level(s) at which testing was begun on the BLAWR-CV or BLAWR-AV. For example, if a child obtained a reading grade level score of 2B (i.e., beginning of second grade) and a spelling grade level score of 1E (i.e., end of first grade), the beginning word lists on the Regular/ Irregular Words Subtest would be Word List 2 for reading and Word List 1 for spelling (see Appendix C for beginning subtest word lists on the BLAWR-CV and BLAWR-AV). Since the word lists on the BLAWR-CV and BLAWR-AV are arranged hierarchically, this procedure allowed the subject to respond to words that were appropriate for his/her reading and spelling level(s). In addition, since the child was responding to words commensurate with his or her reading and spelling ability, it was possible to conduct an error analysis on the child's typical error patterns.

For the reading portions of the BLAWR-CV and BLAWR-AV, the subject was presented with a 3x5 card on which a single real word or nonword was printed in lower case letters (i.e., Helvetica, regular, 24 point). The subject was instructed to read the real word or nonword aloud. If the subject did not attempt to read a real word or nonword,

he/she was encouraged to do so. If still no attempt was made to read the word the next word was presented. The examiner recorded verbatim each response, with incorrect real words and nonwords transcribed phonetically onto the test form. A self-corrected response was scored as correct. However, the incorrect response was recorded also for later analysis.

For the written spelling portions of the BLAWR-CV and BLAWR-AV, the subject was asked to write each of the real words or nonwords that was dictated to him/her. On the real word subtests, the examiner pronounced each word and then the subject was asked to write the word. For each subject, a small portion of the words (approximately one word list or 20 words) was repeated by the subject before they were written to ensure that the subject was adequately perceiving the stimuli. On the Nonword Subtest, the examiner pronounced the nonword, the subject was asked to repeat the nonword and then the subject was asked to write the nonword. If the nonword was repeated incorrectly by the subject, the examiner continued to present the nonword to the subject until it was repeated correctly. In no instance was it necessary to repeat a word more than twice before a subject repeated it correctly.

Reading and Spelling Scoring Procedures

Task 1: Wide Range Achievement Test-Revised

Responses on the reading and spelling subtests of the WRAT were scored as correct or incorrect as prescribed in

the test manual. The total number correct, on the reading and spelling subtests respectively, was used to determine the raw score. The reading and spelling raw scores were then used to determine the grade level based on the norms provided in the test manual (Jastak & Wilkinson, 1984). Each subject was assigned a grade level for both reading and spelling (see Appendix A).

Task 2: Lindamood Auditory Conceptualization Test

Responses on the LACT were scored as correct or incorrect as prescribed in the test manual. A raw score was obtained by summing the correct responses in each category. The raw scores were then converted to a total score, with 100 points being the highest possible score. In order to obtain a grade level score, each subject's total score was compared to the recommended minimum scores by grade level found on the LACT test form. According to Lindamood and Lindamood (1971), the recommended minimum scores "should be considered minimal levels of performance which would indicate a high probability of reading and spelling performance at or above grade level" (p. 30) (see Appendix A).

Task 3: Battery of Linguistic Analysis for Writing and Reading - Children's Version and Battery of Linguistic Analysis for Writing and Reading - Adult Version

For the nonword reading and writing portions of the BLAWR-CV and BLAWR-AV responses were scored as correct or

incorrect. Correct responses were defined as those responses that accurately represented the phonology of the stimulus item. The percentage of nonwords read and spelled correctly was calculated for each subject. Similarly, responses on the real word reading and writing portions of the BLAWR-CV and BLAWR-AV were scored as correct or incorrect. In order to be scored correct, the word had to be pronounced or spelled exactly with no substitutions, omissions, additions or other errors. Incorrect responses on the reading subtests were phonetically transcribed, whereas correct responses were recorded verbatim orthographically. The percentages of real words read and spelled correctly were determined for each subject based on word type (i.e., regular, irregular, and ambiguous words).

Reading and Spelling Strategies Coding System

All incorrect responses on the reading and writing portions of the BLAWR-CV and BLAWR-AV were subjected to analysis. The analysis system used in this study was developed by the investigator based on Frith's (1985) model of reading and spelling development and on a review of the error analysis systems described in the literature (Bruck, 1988; Bruck & Waters, 1988; Cromer, 1980; Holmes & Peper, 1977; Snowling, Stackhouse & Rack, 1986; Waters, Bruck & Seidenberg, 1985). The current analysis system was specifically designed to investigate the logographic and alphabetic reading and spelling systems. Alphabetic

(phonological) errors have been interpreted as indicating a phonological or alphabetic strategy to reading or writing. Whereas, logographic (visual) errors have been interpreted as indicating a visual or logographic approach to reading or spelling. Four categories were developed and used in both the reading and spelling analysis; logographic, logophonic, semi-alphabetic and alphabetic. Correct nonwords were included in the alphabetic category since a correct rendering of a nonword reflects the use of an alphabetic strategy. The categories are defined below for reading and spelling, respectively.

Reading Categories

1. Logographic - (visual errors) - a response which is visually similar to the target word and shares 50% or more of its phonemes with its target (e.g., hardness/harness; butter/better; bone/done). Errors of this type are always real words.

2. Logophonic - (semi-logographic errors) - A response which is visually similar to the target word but shares less than 50% of its phonemes with its target (e.g., water/with; turtle/things; help/have). Errors of this type are always real words. Logophonic errors are felt to reflect partial use of grapheme-phoneme skills.

3. Semi-alphabetic - (semi-phonological error) - A response in which there is an attempt to apply grapheme-phoneme correspondence rules but they are a) applied

inaccurately or b) lack the necessary blending of sound segments in order to synthesize the correct pronounciation (e.g., [seɪd]/steady; [glat]/grill; [pʌ]/prince. Errors of this type are always nonwords.

4. Alphabetic - (phonological error) - A response which is an acceptable phonic rendering of the target word. These errors usually occurred on irregular words and are sometimes called "regularzations" (e.g., [mɛneɪs]/menace; [krɪsɪs]/crisis; [mɪstʃif]/mischief. Errors of this type are always nonwords. Two specific resources were used in order to determine what errors are acceptable as phonological errors, The Structure of English Orthography (Venezky, 1970) and Rules of Pronunciation for the English Language (Wijk, 1966). From these references, a list of acceptable common vowel and consonant substitutions was generated and used to determine whether an error was phonologically acceptable or unacceptable. Appendix D provides a list of the acceptable vowel and consonant substitutions utilized in this study).

Spelling Categories

1. Logographic - (visual error) - a mis-spelling which is visually similar to the target word and shares 50% or more of its graphemes with its target (e.g., swap/swamp; rest/reset; dawn/down). Errors of this type are always real words. Logographic errors which are acceptable phonic renderings (e.g., bran/brain) are excluded from this

category since there is the possibility that they occurred after sound analysis of the word.

2. Logophonic - (semi-logographic errors) - A mis-spelling which is visually similar to the target word but shares less than 50% of its graphemes with its target (e.g., sod/should; press/breeze). Errors of this type are always real words. Logophonic errors are felt to reflect partial use of phoneme-grapheme skills.

3. Semi-alphabetic - (nonphonological error) - A misspelling which contains an omission, addition, or substitution of some phonemic element and which cannot be pronounced by application of grapheme-phoneme correspondence rules or by analogy to another word (e.g., gril/girl; bodt/bottle; hekherchif/handkerchief). Errors of this type are always nonwords.

4. Alphabetic - (phonological error) - A mis-spelling which can be pronounced like the target word either by application of grapheme-phoneme correspondence rules or by analogy to another word (e.g., raindeer/reindeer; cotten/cotton; speach/speech; chef/chief). Errors of this type are always nonwords.

Reliability

Inter-rater reliability was established separately for reading and spelling for judgements of strategy type classification of the subjects' responses on the BLAWR-CV and BLAWR-AV. A professor in Speech/Language Pathology at

the University of Florida and the investigator served as reliability judges. Prior to coding the reading and spelling errors, the reading and spelling analysis systems were reviewed and discussed. The complete reading and spelling data from four of the subjects, one subject each from grades one, two, three and four reading ability, were used during reliability training. During the training sessions any discrepancies in error type classification between the judges were resolved through discussion. The two judges then independently rated 20% of the reading data and 20% of the spelling data. Reading and spelling data were randomly selected from the various WRAT-R reading levels to ensure the likelihood that a wide variety of error types would be represented in the sample. Data sets from five subjects with WRAT-R reading scores of beginning first grade (1B), end of second grade (2E), beginning third grade (3B), beginning fourth grade (4B), and end of fourth grade (4E), were selected to establish reliability for the error type classification system for reading. Data sets from five different subjects with WRAT-R reading scores of beginning second grade (2B), end of second grade (2E), end of third grade (3E), beginning fourth grade (4B), and beginning fifth grade (5B), were selected to establish reliability for the strategy type classification system for spelling. The four subjects initially chosen for the error type classification training sessions were not included in establishing

reliability for the reading and spelling analysis systems. There was 92% agreement, with a range of 88% to 93% agreement, on strategy type classification for the reading analysis system and 93% agreement, with a range of 89% to 98% agreement, on strategy type classification for the spelling analysis system.

RESULTS

The purpose of this study was to examine reading and spelling development in two groups of first through fourth grade children (less skilled and more skilled readers) utilizing an experimental reading and spelling assessment instrument, the Battery of Linguistic Analysis of Writing and Reading - Children's Version (BLAWR-CV) (Roeltgen, 1987) and a measure of phonological awareness, the Lindamood Auditory Conceptualization Test (LACT) (Lindamood & Lindamood, 1971). The types of strategies used by less skilled and more skilled readers when reading and spelling single real words and nonwords were compared to answer the following questions: (1) Do the types of reading and spelling strategies used by the two groups support Frith's developmental stage model for reading and spelling at the logographic and alphabetic stages; (2) Is there a significant difference in the types of strategies used by the two groups; (3) Does the type of word read or spelled have an effect on the type of strategy used; and, (4) Do scores on the LACT strongly correlate with the ability to read and or spell real words and nonwords?

A repeated measures analysis of variance (ANOVA) statistical procedure was used to identify effects of word

type and strategy type in reading and spelling for less skilled and more skilled readers. Since the dependent measures of word type and strategy type were proportions of errors and the distribution of proportions may not be normal, the alpha level was set conservatively at .01 for these significance tests as ANOVA's tend to be robust to departures from normality. The Pearson product-moment correlation statistical procedure was used to determine relationships between the ability to apply an alphabetic strategy when reading and/or spelling nonwords and scores obtained on the LACT. An alpha level of .05 was used for interpretation of these statistical analyses. Descriptive statistics also are presented to characterize each reading group in terms of the dependent measures of word type and strategy type for both reading and spelling.

Reading Data: Comparative and Descriptive Analyses

Strategy Type and Word Type Effects

A repeated measures ANOVA was used to examine within-subject effects on the occurrence of the four strategy types (logographic, logophonic, semi-alphabetic, and alphabetic) for the three word types (regular words, irregular words, and nonwords) for less skilled and more skilled readers. The analysis was performed with Reading Group as the between-subjects factor and Strategy Type and Word Type as the within-subject factors. Highly significant main effects

were found for Reading Group ($F(1,22)=19.62$, $p=.0002$), Strategy Type ($F(3,66)=13.72$, $p=.0001$) and Word Type ($F(2,44)=201.03$, $p=.0001$). Highly significant interaction effects also were found for Strategy Type x Reading Group ($F(3,66)=14.42$, $p=.0001$), Word Type x Reading Group ($F(2,44)=13.48$, $p=.0001$), Strategy Type x Word Type ($F(6,132)=79.62$, $p=.0001$) and Strategy Type x Word Type x Reading Group ($F(6,132)=14.33$, $p=.0001$) (see Tables 1-4).

Strategy Type Effects: Regular, Irregular, and Nonword Data Combined

A repeated measures ANOVA was used to examine within-subject effects on the occurrence of the four strategy types (logographic, logophonic, semi-alphabetic, and alphabetic). The analysis was performed with Reading Group as the between-subjects factor and Strategy Type as the within-subjects factor. Highly significant main effects were found for Reading Group ($F(1,22)=19.62$, $p=.0002$) and Strategy Type ($F(3,66)=13.72$, $p=.0001$) as well as highly significant Srategy Type x Reading Group interaction ($F(3,66)=14.42$, $p=.0001$) as shown in Tables 5 and 6.

The data were analyzed for simple interaction effects of Strategy Type in four separate one-way (less skilled vs more skilled readers) ANOVA's. A summary of these ANOVA's is reported in Table 7. The analyses resulted in highly significant interaction effects for each Strategy Type.

Table 1. Repeated Measures ANOVA: Strategy Types and Word Types by Group: Between-Subject Effects

Source	DF	SS	F	Pr > F
Group	1	0.188	19.62	0.0002
Error	22	0.211	-----	------

Table 2. Repeated Measures ANOVA: Strategy Types and Word Types by Group: Strategy Types, Within-Subject Effects

Source	DF	SS	F	Pr > F
Strategy Type	3	1.364	13.72	0.0001
Strategy Type x Group	3	1.433	14.42	0.0001
Error	66	2.187	-----	------

Table 3. Repeated Measures ANOVA: Strategy Types and Word Types by Group: Word Types, Within-Subject Effects

Source	DF	SS	F	Pr > F
Word Type	2	1.438	201.03	0.0001
Word Type x Group	2	0.096	13.48	0.0001
Error	44	0.157	-----	------

Table 4. Repeated Measures ANOVA: Strategy Types and Word Types by Group: Within-Subject Effects

Source	DF	SS	F	Pr > F
Strategy Type x Word Type	6	3.727	79.62	0.0001
Strategy Type x Word Type x Group	6	0.671	14.33	0.0001
Error	132	1.030	-----	------

Table 5. Repeated Measures ANOVA: Strategy Types by Group: Between-Subject Effects

Source	DF	SS	F	Pr > F
Group	1	0.564	19.62	0.0002
Error	22	0.633	-----	------

Table 6. Repeated Measures ANOVA: Strategy Types by Group: Within-Subject Effects

Source	DF	SS	F	Pr > F
Strategy Type	3	4.091	13.72	0.0001
Strategy Type x Group	3	4.210	14.42	0.0001
Error	66	6.561	-----	------

Table 7. One-Way ANOVA's: Strategy Types by Group: Reading Regular Words, Irregular Words, and Nonwords

Strategy Type	Source	DF	SS	F	Pr > F
Logographic	Group	1	0.698	27.37	0.0001
	Error	22	0.561	-----	------
Logophonic	Group	1	1.491	7.01	0.0147
	Error	22	4.682	-----	------
Semi-alphabetic	Group	1	0.716	22.07	0.0001
	Error	22	0.713	-----	------
Alphabetic	Group	1	1.960	34.83	0.0001
	Error	22	1.238	-----	------

When reading single words, the less skilled readers used logographic ($F(1,22)=27.37$, $p=.0001$), logophonic ($F(1,22)=7.01$, $p=.0147$) and semi-alphabetic ($F(1,22)=22.07$, $p=.0001$) strategies significantly more often than the more skilled readers. The more skilled readers used an alphabetic strategy ($F(1,22)34.83$, $p=0001$) significantly more often than the less skilled readers.

Percentage means and standard deviations for the four strategy types (logographic, logophonic, semi-alphabetic, and alphabetic) used by the less skilled and the more skilled readers when reading single real words and nonwords are presented in Table 8.

Strategy Type Effects: Regular Words and Irregular Wrods

A repeated measures ANOVA was used to examine within-subject effects on the occurrence of the four strategy types (logographic, logophonic, semi-alphabetic, and alphabetic) when reading REGULAR and IRREGULAR words. The analysis was performed with Reading Group as the between-subjects factor and Strategy Type and Word Type as the within-subjects factors. Highly significant main effects were found for Reading Group ($F(1,22)=19.59$, $p=.0002$) and Word Type ($F(1,22)=57.31$, $p=.0001$. There was no significant main effect for Strategy Type. Highly significant interaction effects were found for Strategy Type x Reading Group ($F(3,66)=6.26$, $p=.0008$) and Strategy Type x Word Type

Table 8. Percentage Means and Standard Deviations: Strategy Types by Group: Reading Regular Words, Irregular Words, and Nonwords

Strategy Type		Less Skilled	More Skilled
Logographic	$\bar{X}$=	0.494	0.153
	S.D.	0.218	0.060
Logophonic	$\bar{X}$	0.519	0.020
	S.D.	0.652	0.022
Semi-alphabetic	$\bar{X}$	0.639	0.293
	S.D.	0.224	0.120
Alphabetic	$\bar{X}$	0.514	1.086
	S.D.	0.294	0.162

($F(3,66)=4.70$, $p=.0049$). There were no significant interaction effects for Word Type x Reading Group or Strategy Type x Word Type x Reading Group (see Tables 9-12).

For REGULAR words and IRREGULAR words, the Strategy Type percentages were analyzed for simple interaction effects in eight separate one-way (less skilled vs more skilled) ANOVA's. For REGULAR words the analyses resulted in significant interactions for logographic ($F(1,22)=8.09$, $p=.0094$) and logophonic ($F(1,22)=7.21$, $p=.0135$) strategies. No significant interaction effects were found for semi-alphabetic or alphabetic strategies for REGULAR words. The less skilled readers used significantly more logographic and logophonic strategies when reading REGULAR words than the more skilled readers. A summary of the ANOVA's for reading REGULAR words is presented in Table 13.

For IRREGULAR words the analyses resulted in significant interaction effects for logographic ($F(1,22)=10.14$, $p=.0043$), logophonic ($F(1,22)=6.89$, $p=.0155$) and alphabetic ($F(1,22)=7.93$, $p=.0100$) strategies. No significant interaction effects were found for the semi-alphabetic strategy. When reading IRREGULAR words, the less skilled readers used significantly more logographic and logophonic strategies than the more skilled readers. However, the more skilled readers used an alphabetic strategy significantly more often than the less skilled

Table 9. Repeated Measures ANOVA: Strategy Types and Word Types by Group: Reading Regular Words and Irregular Words, Between-Subject Effects

Source	DF	SS	F	Pr > F
Group	1	0.282	19.59	0.0002
Error	22	0.317	-----	------

Table 10. Repeated Measures ANOVA: Strategy Types and Word Types by Group: Reading Regular Words and Irregular Words, Within-Subject Effects of Strategy Types

Source	DF	SS	F	Pr > F
Strategy Type	3	0.074	1.15	0.3341ns*
Strategy Type x Group	3	0.401	6.26	0.0008
Error	66	1.412	----	------

*ns = nonsignificant

Table 11. Repeated Measures ANOVA: Strategy Types and Word Types by Group: Reading Regular Words and Irregular Words, Within-Subject Effects of Word Types

Source	DF	SS	F	Pr > F
Word Type	1	0.135	57.31	0.0001
Word Type x Group	1	0.003	1.10	0.3061ns*
Error	22	0.052	-----	------

*ns = nonsignificant

Table 12. Repeated Measures ANOVA: Strategy Types and Word Types by Group: Reading Regular Words and Irregular Words, Within-Subject Effects

Source	DF	SS	F	Pr > F
Strategy Type x Word Type	3	0.099	4.70	0.0049
Strategy Type x Word Type x Group	3	0.027	1.26	0.2941ns*
Error	66	0.463	----	------

*ns = nonsignificant

Table 13. One-Way ANOVA's: Strategy Types by Group: Reading Regular Words

Strategy Type	Source	DF	SS	F	Pr > F
Logographic	Group	1	0.096	8.09	0.0094
	Error	22	0.261	----	------
Logophonic	Group	1	0.199	7.21	0.0135
	Error	22	0.606	----	------
Semi-alphabetic	Group	1	0.012	2.93	0.1012ns*
	Error	22	0.087	----	------
Alphabetic	Group	1	0.002	1.43	0.2442ns*
	Error	22	0.025	----	------

*ns = nonsignificant

readers when reading IRREGULAR words. A summary of the ANOVA's for reading IRREGULAR words is reported in Table 14.

Percentage means and standard deviations for the four strategy types (logographic, logophonic, semi-alphabetic, and alphabetic) used by the less skilled and the more skilled readers when reading REGULAR words and IRREGULAR words are presented in Tables 15 and 16, respectively.

In summary, the less skilled readers used a logographic and logophonic strategy significantly more often when reading both REGULAR and IRREGULAR words than the more skilled readers. The more skilled readers used an alphabetic strategy significantly more often than the less skilled readers when reading IRREGULAR words. There were no significant differences between the two groups for the use of a semi-alphabetic strategy when reading REGULAR words and IRREGULAR words or for the use of an alphabetic strategy when reading REGULAR words.

Strategy Type Effects: Nonwords

Repeated measures ANOVA was used to examine within-subject effects on the occurrence of the four strategy types (logographic, logophonic, semi-alphabetic, and alphabetic) when reading NONWORDS. The analysis was performed with Reading Group as the between-subjects factor and Strategy Type as the within-subject factor. There was no significant main effect for Reading Group. There was a highly significant main effect for Strategy Type ($F(3,66)=80.59$,

Table 14. One-Way ANOVA's: Strategy Types by Group: Reading Irregular Words

Strategy Type	Source	DF	SS	F	Pr > F
Logographic	Group	1	0.063	10.14	0.0043
	Error	22	0.138	----	------
Logophonic	Group	1	0.240	6.89	0.0155
	Error	22	0.765	----	------
Semi-alphabetic	Group	1	0.037	4.47	0.0461
	Error	22	0.182	----	------
Alphabetic	Group	1	0.065	7.93	0.0100
	Error	22	0.180	----	------

Table 15. Percentage Means and Standard Deviations: Strategy Types by Group: Reading Regular Words

Strategy Type		Less Skilled	More Skilled
Logographic	$\bar{X}$=	0.168	0.042
	S.D.	0.148	0.042
Logophonic	$\bar{X}$	0.185	0.003
	S.D.	0.234	0.010
Semi-alphabetic	$\bar{X}$	0.121	0.077
	S.D.	0.077	0.044
Alphabetic	$\bar{X}$	0.017	0.034
	S.D.	0.032	0.035

Table 16. Percentage Means and Standard Deviations: Strategy Type by Group: Reading Irregular Words

Strategy Type		Less Skilled	More Skilled
Logographic	$\bar{X}$=	0.157	0.054
	S.D.	0.108	0.029
Logophonic	$\bar{X}$	0.213	0.013
	S.D.	0.263	0.022
Semi-alphabetic	$\bar{X}$	0.216	0.137
	S.D.	0.123	0.037
Alphabetic	$\bar{X}$	0.088	0.192
	S.D.	0.062	0.112

p=.0001) and a highly significant interaction effect for Strategy Type x Reading Group (F(3,66)=27.47, p=.0001) (see Tables 17 and 18).

The NONWORD data were analyzed for simple interaction effects for Strategy Type in four separate one-way (less skilled vs more skilled) ANOVA's. A summary of the ANOVA's is presented in Table 19. The analyses resulted in highly significant interaction effects for the logographic (F(1,22)=34.95, p=.0001), semi-alphabetic (F(1,22)=40.17, p=.0001) and alphabetic (F(1,22)=44.17, p=.0001) strategies. No significant interaction was found for the logophonic strategy. When reading NONWORDS, the less skilled readers used logographic and semi-alphabetic strategies significantly more often than the more skilled readers. The more skilled readers used an alphabetic strategy significantly more often than the less skilled readers when reading NONWORDS.

Percentage means and standard deviations for the four strategy types (logographic, logophonic, semi-alphabetic, and alphabetic) used by the less skilled and the more skilled readers when reading NONWORDS are summarized in Table 20.

In summary, the less skilled readers used logographic and semi-alphabetic strategies significantly more often when reading NONWORDS than the more skilled readers. The more

Table 17. Repeated Measures ANOVA: Strategy Types by Group: Reading Nonwords, Between-Subject Effects

Source	DF	SS	F	Pr > F
Group	1	0.000	1.80	0.1934
Error	22	0.000	----	------

Table 18. Repeated Measures ANOVA: Strategy Types by Group: Reading Nonwords, Within-Subject Effects

Source	DF	SS	F	Pr > F
Strategy Type	3	4.918	80.59	0.0001
Strategy Type x Group	3	1.676	27.47	0.0001
Error	66	1.343	-----	------

Table 19. One-Way ANOVA's Strategy Types by Group: Reading Nonwords

Strategy Type	Source	DF	SS	F	Pr > F
Logographic	Group	1	0.075	34.95	0.0001
	Error	22	0.047	----	------
Logophonic	Group	1	0.082	3.43	0.0775ns
	Error	22	0.524	----	------
Semi-alphabetic	Group	1	0.298	40.17	0.0001
	Error	22	0.163	----	------
Alphabetic	Group	1	1.220	44.17	0.0001
	Error	22	0.608	----	------

*ns = nonsignificant

Table 20. Percentage Means and Standard Deviations: Strategy Types by Group: Reading Nonwords

Strategy Type		Less Skilled	More Skilled
Logographic	$\bar{X}$=	0.169	0.057
	S.D.	0.055	0.036
Logophonic	$\bar{X}$	0.121	0.004
	S.D.	0.218	0.008
Semi-alphabetic	$\bar{X}$	0.302	0.079
	S.D.	0.108	0.057
Alphabetic	$\bar{X}$	0.408	0.860
	S.D.	0.223	0.076

skilled readers used an alphabetic strategy significantly more often than the less skilled readers when reading NONWORDS.

Word Type Effects: Regular, Irregular and Nonwords

Repeated measures ANOVA was used to examine within-subject effects of Word Type. The analysis was performed with Reading Group as the between-subjects factor and Word Type as the within-subject factor. Highly significant main effects were found for Reading Group ($F(1,22)=31.25$, $p=.0001$) and Word Type ($F(2,44)=37.54$, $p=.0001$). No significant interaction effect was found for Word Type x Reading Group (see Tables 21 and 22).

The percentage of REGULAR, IRREGULAR, and NONWORDS read correctly were analyzed for simple interaction effects in three separate one-way (less skilled vs more skilled ANOVA's. A summary of the ANOVA's is presented in Table 23. The analysis resulted in highly significant interaction effects for each Word Type. The more skilled readers had significantly more correct REGULAR ($F(1,22)=15.62$, $p=.0007$), IRREGULAR ($F(1,22)=18.75$, $p=.0003$) and NONWORDS ($F(1,22)=56.54$, $p=.0001$) than the less skilled readers.

A Pearson product-moment correlation was used to determine if there was a significant relationship between the ability to read the various word types correctly. For the less skilled readers there was a significant high

Table 21. Repeated Measures ANOVA: Word Types by Group: Reading Regular Words, Irregular Words, and Nonwords, Between-Subject Effects

Source	DF	SS	F	Pr > F
Group	1	2.126	31.25	0.0001
Error	22	1.497	-----	------

Table 22. Repeated Measures ANOVA: Word Types by Group: Reading Regular Words, Irregular Words, and Nonwords, Within-Subject Effects

Source	DF	SS	F	Pr > F
Word Type	2	0.677	37.54	0.0001
Word Type x Group	2	0.067	3.74	0.0317ns*
Error	44	0.397	-----	------

* ns = nonsignificant

Table 23. One-Way ANOVA's: Word Types by Group: Reading Regular Words, Irregular Words, and Nonwords

Word Type	Source	DF	SS	F	Pr > F
Regular Words	Group	1	0.676	15.62	0.0007
	Error	22	0.953	-----	------
Irregular Words	Group	1	0.447	18.75	0.0003
	Error	22	0.524	-----	------
Nonwords	Group	1	1.070	56.54	0.0001
	Error	22	0.416	-----	------

correlation between the ability to read REGULAR words correctly and the ability to read IRREGULAR words correctly (r=.8536; p=.05) and NONWORDS correctly (r=.8043; p=.05). There was a significant moderate correlation between the ability to read IRREGULAR words and NONWORDS correctly (r=.7052; p=.05) in the less skilled group. All of the correlations between the ability to read the word types correctly were nonsignificant and low for the more skilled readers.

The mean percent of REGULAR words, IRREGULAR words, and NONWORDS read correctly by the less skilled and the more skilled reading groups are depicted in Figure 1.

Correlation Between LACT Scores and Reading Real Words and Nonwords

A Pearson product-moment correlation was used to determine if there was a significant relationship between the ability to read NONWORDS correctly and scores obtained on the LACT. The mean total LACT score was 46.75 for the less skilled readers and 79.50 for the more skilled readers. The mean percentages of nonwords read correctly by the less skilled and the more skilled readers are depicted in Figure 1. For both the less skilled readers and the more skilled readers there was a low nonsignificant correlation between the ability to read NONWORDS correctly and scores obtained on the LACT. However, when the two groups were combined, a moderate significant correlation was found between the

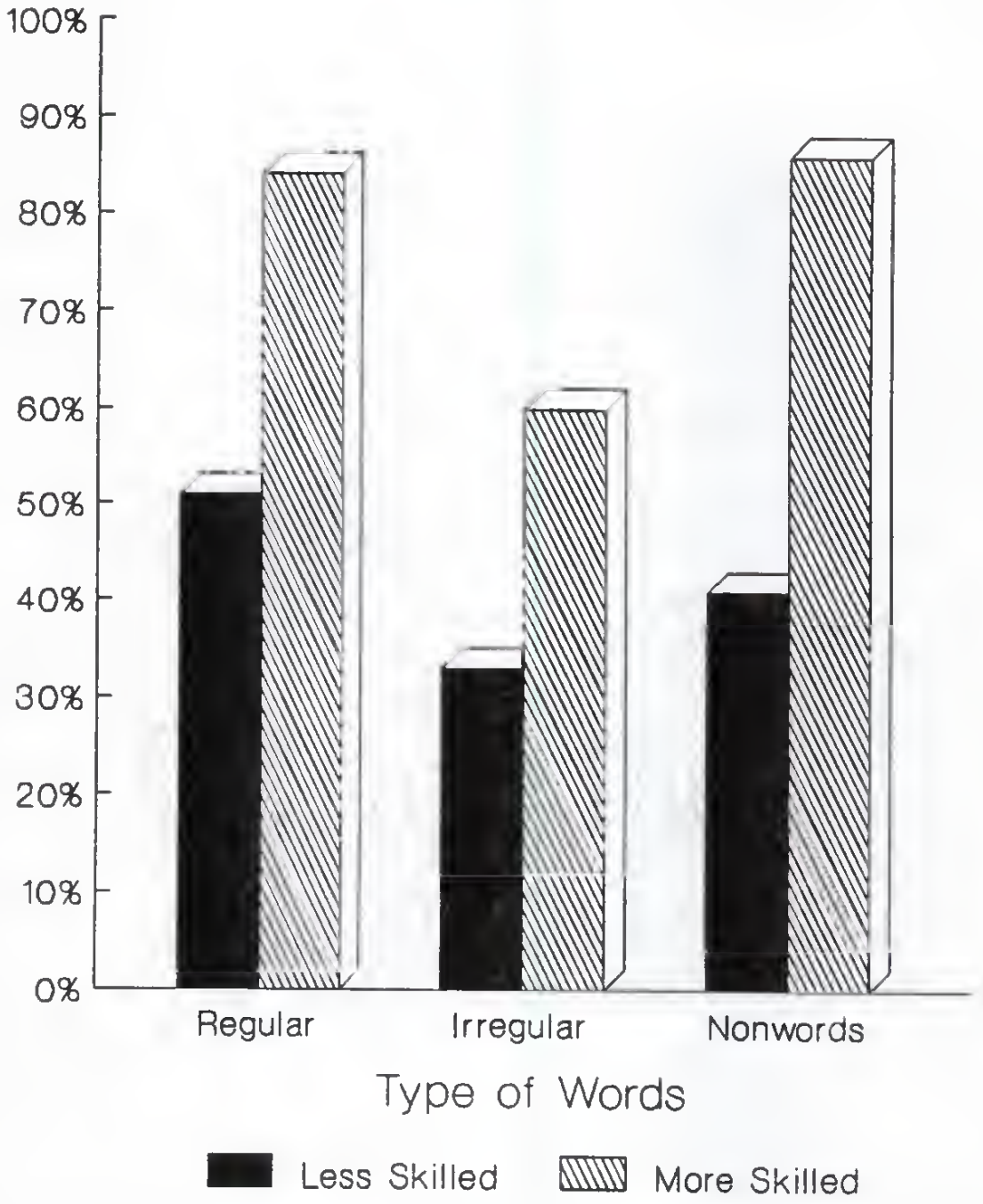

Figure 1. Mean Percent Correct When Reading Regular Words, Irregular Words and Nonwords for Less Skilled and More Skilled Readers

ability to read NONWORDS (r=.7257, p=.05) correctly and scores on the LACT.

Spelling Data: Comparative and Descriptive Analyses

Strategy Type and Word Type Effects

A repeated measures ANOVA was used to examine within-subject effects on the occurrence of the four strategy types (logographic, logophonic, semi-alphabetic, and alphabetic) for the four word types (regular words, irregular words, ambiguous words, and nonwords). The analysis was performed with Reading Group as the between-subjects factor and Strategy Type and Word Type as the within-subject factors (only 22 observations were used in this analysis since two of the less skilled readers did not attempt to spell any of the irregular words). Highly significant main effects were found for Reading Group ($F(1,20)=18.55$, $p=.0003$), Strategy Type ($F(3,60)=49.39$, $p=.0001$) and Word Type ($F(3,60)=115.76$, $p=.0001$). Highly significant interaction effects also were found for Strategy Type x Reading Group ($F(3,60)=7.65$, $p=.0002$), Word Type x Reading Group ($F(3,60)=8.33$, $p=.0001$), Strategy Type x Word Type ($F(9,180)=38.81$, $p=.0001$) and Strategy Type x Word Type x Reading Group ($F(9,180)=8.87$, $p=.0001$) (see Tables 24-27).

Table 24. Repeated Measures ANOVA: Strategy Types and Word Types by Group: Between-Subject Effects

Source	DF	SS	F	Pr > F
Group	1	0.148	18.55	0.0003
Error	20	0.160	-----	------

Table 25. Repeated Measures ANOVA: Strategy Types and Word Types by Group: Strategy Types, Within-Subject Effects

Source	DF	SS	F	Pr > F
Strategy Type	3	7.340	49.39	0.0001
Strategy Type x Group	3	1.137	7.65	0.0002
Error	60	2.973	-----	------

Table 26. Repeated Measures ANOVA: Strategy Types and Word Types by Group: Word Types, Within-Subject Effects

Source	DF	SS	F	Pr > F
Word Type	3	0.873	115.76	0.0001
Word Type x Group	3	0.063	8.33	0.0001
Error	60	0.151	------	------

Table 27. Repeated Measures ANOVA: Strategy Types and Word Types by Group: Within-Subject Effects

Source	DF	SS	F	Pr > F
Strategy Type x Word Type	9	1.990	38.81	0.0001
Strategy Type x Word Type x Group	9	0.455	8.87	0.0001
Error	180	1.025	-----	------

Strategy Type Effects: Regular, Irregular, Ambiguous, and Nonword Data Combined

A repeated measures ANOVA was used to examine within-subject effects on the occurrence of the four strategy types (logographic, logophonic, semi-alphabetic, and alphabetic). The analysis was performed with Reading Group as the between-subjects factor and Strategy Type as the within-subject factor. Highly significant main effects were found for Reading Group ($F(1,22)=18.84$, $p=.0003$) and Strategy Type ($F(3,66)=58.45$, $p=.0001$) as well as a highly significant Strategy Type x Reading Group ($F(3,66)=10.02$, $p=.0001$) interaction (see Tables 28 and 29).

The data were analyzed for simple interaction effects of Strategy Type in four separate one-way (less skilled vs more skilled) ANOVA's. A summary of these ANOVA's is reported in Table 30. The analyses resulted in highly significant interaction effects for logographic ($F(1,22)=20.73$, $p=.0002$), semi-alphabetic ($F(1,22)=11.21$, $p=.0029$) and alphabetic ($F(1,22)=8.42$, $p=.0083$) strategies. No significant interaction effect was found for the logophonic strategy. When spelling single words, the less skilled readers used significantly more logographic and semi-alphabetic strategies than the more skilled readers. The more skilled readers used an alphabetic strategy significantly more often than the less skilled readers.

Table 28. Repeated Measures ANOVA: Strategy Types by Group: Between-Subject Effects

Source	DF	SS	F	Pr > F
Group	1	0.574	18.84	0.0003
Error	22	0.671	-----	------

Table 29. Repeated Measures ANOVA: Strategy Types by Group: Within-Subject Effects

Source	DF	SS	F	Pr > F
Strategy Type	3	31.954	58.45	0.0001
Strategy Type x Group	3	5.478	10.02	0.0001
Error	66	12.027	-----	------

Table 30. One-Way ANOVA's: Strategy Types by Group: Spelling Regular Words, Irregular Words, Ambiguous Words, and Nonwords

Strategy Type	Source	DF	SS	F	Pr > F
Logographic	Group	1	0.278	20.73	0.0002
	Error	22	0.295	-----	------
Logophonic	Group	1	0.030	4.83	0.0389ns*
	Error	22	0.135	-----	------
Semi-alphabetic	Group	1	4.216	11.21	0.0029
	Error	22	8.272	-----	------
Alphabetic	Group	1	1.529	8.42	0.0083
	Error	22	3.996	-----	------

* ns = nonsignificant

Percentage means and standard deviations for the four strategy types (logographic, logophonic, semi-alphabetic, and alphabetic) used by the less skilled and the more skilled readers when spelling single real words and nonwords are presented in Table 31.

Strategy Type Effects: Regular Words, Irregular Words, and Ambiguous Words

Repeated measures ANOVA was used to examine within-subject effects on the occurrence of the four strategy types (logographic, logophonic, semi-alphabetic, and alphabetic) when spelling REGULAR, IRREGULAR, and AMBIGUOUS words. The analysis was performed with Reading Group as the between-subjects factor and Strategy Type and Word Type as the within-subject factor. Highly significant main effects were found for Reading Group ($F(1,20)=18.56$, $p=.0003$), Strategy Type ($F(3,60)=36.57$, $p=.0001$) and Word Type ($F(2,40)=25.58$, $p=.0001$). Significant interaction effects were found for Strategy Type x Reading Group ($F(3,60)=6.35$, $p=.0001$) and Strategy Type x Word Type x Reading Group ($F(6,120)=2.80$, $p=.0138$). There was no significant interaction for Word Type x Reading Group (see Tables 32-35).

For REGULAR words, IRREGULAR words, and AMBIGUOUS words, the data were analyzed for simple interaction effects of Strategy Type in twelve separate one-way (less skilled vs more skilled) ANOVA's (two of the less skilled readers did not attempt to spell any IRREGULAR words so 22 rather than

Table 31. Percentage Means and Standard Deviations: Strategy Types by Reading Group: Spelling Regular Words, Irregular Words, Ambiguous Words, and Nonwords

Strategy Type		Less Skilled	More Skilled
Logographic	$\bar{X}$=	0.274	0.059
	S.D.	0.159	0.038
Logophonic	$\bar{X}$	0.076	0.006
	S.D.	0.109	0.019
Semi-alphabetic	$\bar{X}$	1.560	0.723
	S.D.	0.824	0.270
Alphabetic	$\bar{X}$	1.096	1.601
	S.D.	0.547	0.254

Table 32. Repeated Measures ANOVA: Strategy Types and Word Types by Group: Spelling Regular Words, Irregular Words, and Ambiguous Words, Between-Subject Effects

Source	DF	SS	F	Pr > F
Group	1	0.198	18.56	0.0003
Error	20	0.213	-----	------

Table 33. Repeated Measures ANOVA: Strategy Types and Word Types by Group: Spelling Regular Words, Irregular Words, and Ambiguous Words, Within-Subject Effects of Strategy Types

Source	DF	SS	F	Pr > F
Strategy Type	3	3.719	36.57	0.0001
Strategy Type x Group	3	0.419	4.12	0.0100
Error	60	2.034	-----	------

Table 34. Repeated Measures ANOVA: Strategy Types and Word Types by Group: Spelling Regular Words, Irregular Words, and Ambiguous Words, Within-Subject Effects of Word Types

Source	DF	SS	F	Pr > F
Word Type	2	0.125	25.58	0.0001
Word Type x Group	2	0.013	2.73	0.0776ns*
Error	40	0.098	-----	------

* ns = nonsignificant

Table 35. Repeated Measures ANOVA: Strategy Types and Word Types by Group: Spelling Regular Words, Irregular Words, and Ambiguous Words, Within-Subject Effects

Source	DF	SS	F	Pr > F
Strategy Type x Word Type	6	0.246	6.35	0.0001
Strategy Type x word Type x Group	6	0.108	2.80	0.0138
Error	120	0.774	----	------

24 observations were used in the analyses). For REGULAR words the analyses resulted in significant interactions for logographic ($F(1.20)=16.29$, $p=.0006$) and semi-alphabetic ($F(1,20)=8.55$, $p=.0084$) strategies. No significant interaction effects were found for logophonic or alphabetic strategies for REGULAR words. The less skilled readers used logographic and semi-alphabetic strategies significantly more often when spelling REGULAR words than the more skilled readers. A summary of the ANOVA's for spelling REGULAR words is reported in Table 36.

For IRREGULAR words, the analyses resulted in significant interaction effects for the logographic ($F(1,20)=13.53$, $p=.0015$) strategy. No significant interaction effects were found for logophonic, semi-alphabetic or alphabetic strategies. When spelling IRREGULAR words, less skilled readers used a logographic strategy significantly more often than the more skilled readers. A summary of the ANOVA's for spelling IRREGULAR words is presented in Table 37.

For AMBIGUOUS words, the analyses resulted in significant interaction effects for the logographic ($F(1,20)=10.25$, $p=.0045$) and semi-alphabetic ($F(1,20)=11.06$, $p=.0034$) strategies. There were no significant interaction effects found for the logophonic or alphabetic strategies. The less skilled readers used a logographic and semi-alphabetic strategy significantly more often than the

Table 36. One-Way ANOVA's: Strategy Types by Group: Spelling Regular Words

Strategy Type	Source	DF	SS	F	Pr > F
Logographic	Group	1	0.047	16.29	0.0006
	Error	20	0.058	-----	------
Logophonic	Group	1	0.000	0.33	0.5728ns*
	Error	20	0.011	-----	------
Semi-alphabetic	Group	1	0.364	8.55	0.0084
	Error	20	0.852	-----	------
Alphabetic	Group	1	0.034	3.97	0.0601ns*
	Error	20	0.169	-----	------

* ns = nonsignificant

Table 37. One-Way ANOVA's: Strategy Types by Group: Spelling Irregular Words

Strategy Type	Source	DF	SS	F	Pr > F
Logographic	Group	1	0.021	13.53	0.0015
	Error	20	0.031	-----	------
Logophonic	Group	1	0.005	2.39	0.1374ns*
	Error	20	0.041	-----	------
Semi-alphabetic	Group	1	0.067	1.47	0.2399ns*
	Error	20	0.915	-----	------
Alphabetic	Group	1	0.007	0.24	0.6291ns*
	Error	20	0.566	-----	------

* ns = nonsignificant

more skilled readers when spelling AMBIGUOUS words. A summary of the ANOVA's for spelling AMBIGUOUS words is reported in Table 38.

Percentage means and standard deviations for the four strategy types (logographic, logophonic, semi-alphabetic, and alphabetic) used by the less skilled and the more skilled readers when spelling REGULAR words, IRREGULAR words and AMBIGUOUS words are presented in Tables 39, 40 and 41, respectively.

In summary, the less skilled readers used a logographic strategy significantly more often than the more skilled readers when spelling REGULAR, IRREGULAR, and AMBIGUOUS words. In addition, the less skilled readers employed a semi-alphabetic strategy when spelling REGULAR and AMBIGUOUS words significantly more often than the more skilled readers.

Strategy Type Effects: Nonwords

A repeated measures ANOVA was used to examine within-subject effects on the occurrence of the four strategy types (logographic, logophonic, semi-alphabetic, and alphabetic) when spelling NONWORDS. The analysis was performed with Reading Group as the between-subjects factor and Strategy Type as the within-subject factor. There was no significant main effect for Reading Group. There was a highly significant main effect for Strategy Type ($F(3,66)=104.98$,

Table 38. One-Way ANOVA's: Strategy Types by Group: Spelling Ambiguous Words

Strategy Type	Source	DF	SS	F	Pr > F
Logographic	Group	1	0.012	10.25	0.0045
	Error	20	0.023	-----	------
Logophonic	Group	1	0.004	1.48	0.2372ns*
	Error	20	0.056	-----	------
Semi-alphabetic	Group	1	0.135	11.06	0.0034
	Error	20	0.244	-----	------
Alphabetic	Group	1	0.043	5.65	0.0276ns*
	Error	20	0.152	-----	------

* ns = nonsignificant

Table 39. Percentage Means and Standard Deviations: Strategy Types by Group: Spelling Regular Words

Strategy Type		Less Skilled	More Skilled
Logographic	$\bar{X}$=	0.092	0.007
	S.D.	0.076	0.017
Logophonic	$\bar{X}$	0.017	0.004
	S.D.	0.039	0.014
Semi-alphabetic	$\bar{X}$	0.463	0.147
	S.D.	0.302	0.070
Alphabetic	$\bar{X}$	0.138	0.214
	S.D.	0.111	0.060

Table 40. Percentage Means and Standard Deviations: Strategy Type by Group: Spelling Irregular Words

Strategy Type		Less Skilled	More Skilled
Logographic	$\bar{X}$=	0.065	0.003
	S.D.	0.058	0.010
Logophonic	$\bar{X}$	0.030	0.000
	S.D.	0.067	0.000
Semi-alphabetic	$\bar{X}$	0.360	0.249
	S.D.	0.290	0.119
Alphabetic	$\bar{X}$	0.360	0.325
	S.D.	0.207	0.129

Table 41. Percentage Means and Standard Deviations: Strategy Type by Group: Spelling Ambiguous Words

Strategy Type		Less Skilled	More Skilled
Logographic	$\bar{X}$=	0.053	0.002
	S.D.	0.048	0.007
Logophonic	$\bar{X}$	0.023	0.000
	S.D.	0.072	0.000
Semi-alphabetic	$\bar{X}$	0.346	0.173
	S.D.	0.141	0.069
Alphabetic	$\bar{X}$	0.196	0.264
	S.D.	0.107	0.069

p=.0001) and a highly significant interaction effect for Strategy Type x Reading Group (F(3,66)=21.95, p=.0001) (see Tables 42 and 43).

The NONWORD data were analyzed for simple interaction effects for Strategy Type in four separate one-way (less skilled vs more skilled) ANOVA's. A summary of the ANOVA's is presented in Table 44. The analyses resulted in highly significant interaction effects for semi-alphabetic (F(1,22)=20.15, p=.0002) and alphabetic (F(1,22)=20.38, p=.0002) strategies. No significant interaction effects were found for the logographic or logophonic strategies. The less skilled readers used a semi-alphabetic strategy significantly more often than the more skilled readers when spelling NONWORDS. Whereas, the more skilled readers used an alphabetic strategy significantly more often than the less skilled readers when spelling NONWORDS.

Percentage means and standard deviations for the four strategy types (logographic, logophonic, semi-alphabetic, and alphabetic) used by the less skilled and the more skilled readers when spelling NONWORDS are summarized in Table 45.

Word Type Effects: Regular, Irregular, Ambiguous, and Nonwords

A repeated measures ANOVA was used to examine within-subject effects of Word Type. The analysis was performed with Reading Group as the between-subjects factor and Word

Table 42. Repeated Measures ANOVA: Strategy Types by Group: Spelling Nonwords, Between-Subjects Effects

Source	DF	SS	F	Pr > F
Group	1	0.000	1.00	0.3282ns*
Error	22	0.000	----	------

* ns = nonsignificant

Table 43. Repeated Measures ANOVA: Strategy Types by Group: Spelling Nonwords, Within-Subject Effects

Source	DF	SS	F	Pr > F
Strategy Type	3	5.823	104.98	0.0001
Strategy Type x Group	3	1.217	21.95	0.0001
Error	66	1.220	------	------

Table 44. One-Way ANOVA's: Strategy Types by Group: Spelling Nonwords

Strategy Type	Source	DF	SS	F	Pr > F
Logographic	Group	1	0.005	2.49	0.1285ns*
	Error	22	0.041	-----	------
Logophonic	Group	1	0.001	3.89	0.0612ns*
	Error	22	0.003	-----	------
Semi-alphabetic	Group	1	0.534	20.15	0.0002
	Error	22	0.583	-----	------
Alphabetic	Group	1	0.589	20.38	0.0002
	Error	22	0.578	-----	------

* ns = nonsignificant

Table 45. Percentage Means and Standard Deviations: Strategy Types by Group: Spelling Nonwords

Strategy Type		Less Skilled	More Skilled
Logographic	$\bar{X}$=	0.075	0.047
	S.D.	0.055	0.027
Logophonic	$\bar{X}$	0.011	0.001
	S.D.	0.016	0.005
Semi-alphabetic	$\bar{X}$	0.451	0.153
	S.D.	0.212	0.089
Alphabetic	$\bar{X}$	0.463	0.799
	S.D.	0.212	0.095

Type as the within-subjects factor. Highly significant main effects were found for Reading Group ($F(1,20)=22.57$, $p=.0001$) and Word Type ($F(3,60)=18.67$, $p=.0001$). No significant interaction effect was found for Word Type x Reading Group (see Tables 46 and 47).

The percentage of REGULAR, IRREGULAR, AMBIGUOUS, and NONWORDS spelled correctly were analyzed for simple interaction effects in four separate one-way (less skilled vs more skilled) ANOVA's (two of the less skilled readers did not attempt to spell any of the irregular words so only 22 observations were used in this analysis). A summary of the ANOVA's is presented in Table 48. The analysis resulted in highly significant interaction effects for each Word Type. The more skilled readers had significantly more correct REGULAR ($F(1,20)=12.19$, $p=.0023$), IRREGULAR ($F(1,20)=21.45$, $p=.0002$), AMBIGUOUS ($F(1,20)=8.60$, $p=.0082$), and NONWORDS ($F(1,20)=22.98$, $p=.0001$) than the less skilled readers.

A Pearson product-moment correlation was used to determine if there was a significant relationship between the ability to spell the various word types correctly. For the less skilled readers there was a significant high correlation between the ability to spell REGULAR words and IRREGULAR words correctly ($r=.8643$; $p=.05$). Moderate correlations were found between the ability to spell REGULAR words and NONWORDS correctly ($r=.7385$; $p=.05$), IRREGULAR

Table 46. Repeated Measures ANOVA: Word Types by Group: Spelling Regular Words, Irregular Words, Ambiguous Words, and Nonwords, Between-Subject Effects

Source	DF	SS	F	Pr > F
Group	1	1.132	22.57	0.0001
Error	20	1.003	------	------

Table 47. Repeated Measures ANOVA: Word Types by Group: Spelling Regular Words, Irregular Words, Ambiguous Words, and Nonwords, Within-Subject Effects

Source	DF	SS	F	Pr > F
Word Type	3	0.504	18.67	0.0001
Word Type x Group	3	0.057	2.12	0.1077ns*
Error	60	0.539	-----	------

* ns = nonsignificant

Table 48. One-Way ANOVA's: Word Types by Group: Spelling Regular Words, Irregular Words, Ambiguous Words, and Nonwords

Word Type	Source	DF	SS	F	Pr > F
Regular Words	Group	1	0.424	12.19	0.0023
	Error	20	0.695	-----	------
Irregular Words	Group	1	0.310	21.45	0.0002
	Error	20	0.289	-----	------
Ambiguous Words	Group	1	0.111	8.60	0.0082
	Error	20	0.259	-----	------
Nonwords	Group	1	0.344	22.98	0.0001
	Error	20	0.299	-----	------

words and NONWORDS correctly (r=.7869; p=.05) and REGULAR words and AMBIGUOUS words correctly (r=.6806; p=.05) for the less skilled readers. The correlations between the ability to spell IRREGULAR words and AMBIGUOUS words and the ability to spell AMBIGUOUS words and NONWORDS were nonsignificant and low for the less skilled readers. For the more skilled readers, all of the correlations between the ability tospell the word types correctly were nonsignificant and low.

The mean percent of REGULAR words, IRREGULAR words, AMBIGUOUS words, and NONWORDS spelled correctly by the less skilled and the more skilled reading groups are depicted in Figure 2.

Correlation Between LACT Scores and Spelling Real Words and Nonwords

A Pearson product-moment correlation was used to determine if there was a significant relationship between the ability to spell NONWORDS correctly and scores obtained on the LACT. The mean total LACT score was 46.75 for the less skilled readers and 79.50 for the more skilled readers. The mean percentages of nonwords spelled correctly by the less skilled and the more skilled readers are depicted in Figure 2. For the less skilled readers, a low nonsignificant correlation was found between the ability to spell NONWORDS and scores on the LACT. For the more skilled readers, a moderate significant correlation was found between the ability to spell NONWORDS (r=.6279; p=.05) and

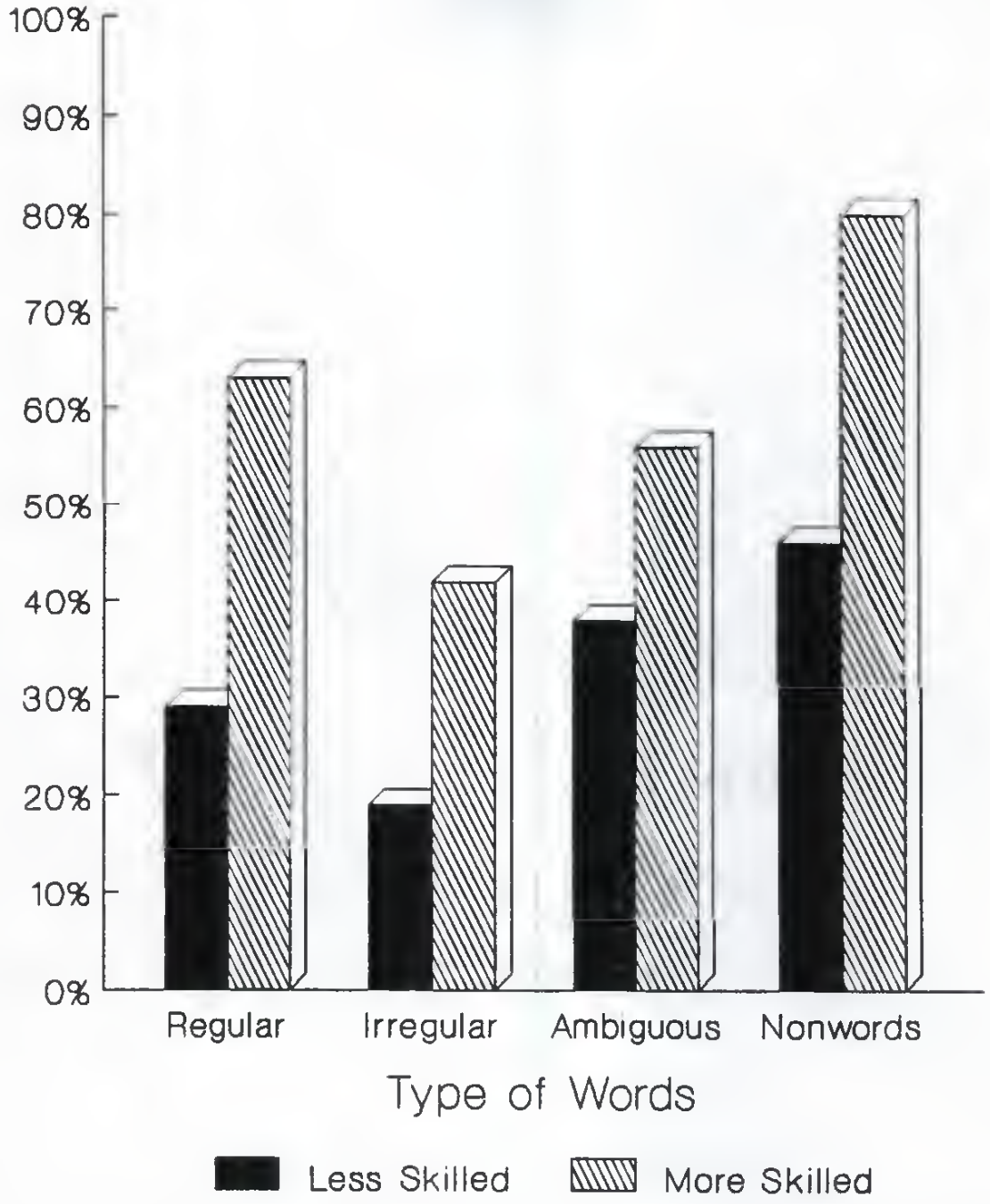

Figure 2. Mean Percent Correct When Spelling Regular Words, Irregular Words, Ambiguous Words and Nonwords for Less Skilled and More Skilled Readers

scores on the LACT. When the two groups were combined, a moderate significant correlation was found between the ability to spell NONWORDS (r=.7653; p=.05) correctly and scores on the LACT.

Overall, there were differences between the less skilled and the more skilled readers in the types of strategies used to read and spell single real words and nonwords. In reading, the less skilled readers used a logographic strategy significantly more often than the more skilled readers when reading REGULAR words, IRREGULAR words, and NONWORDS. The less skilled readers also used a logophonic strategy significantly more often than the more skilled readers when reading REGULAR and IRREGULAR words and a semi-alphabetic strategy significantly more often when reading NONWORDS. The more skilled readers used an alphabetic strategy significantly more often than the less skilled readers when reading IRREGULAR words and NONWORDS (see Table 49). The more skilled readers also read significantly more REGULAR words, IRREGULAR words and NONWORDS correctly than the less skilled readers. When the less skilled and the more skilled groups were combined, a moderate correlation was found between the ability to read NONWORDS correctly and scores obtained on the LACT.

In spelling, the less skilled readers used a logographic strategy significantly more often than the more skilled readers when spelling REGULAR words, IRREGULAR

Table 49. Comparison of Reading Strategies Used by Less Skilled and More Skilled Readers for the Three Word Types

	Logographic	Logophonic	Semi-alphabetic	Alphabetic
Regular Words	LS > MS*	LS > MS*	LS > MS	LS < MS
Irregular Words	LS > MS*	LS > MS*	LS > MS	LS < MS*
Nonwords	LS > MS*	LS > MS	LS > MS*	LS < MS*

LS = Less Skilled
MS = More Skilled
* Significant at $p \leq .01$

words, and AMBIGUOUS words. The less skilled readers also used a semi-alphabetic strategy significantly more often than the more skilled readers when spelling REGULAR words, AMBIGUOUS words, and NONWORDS. The more skilled readers used an alphabetic strategy significantly more often than the less skilled readers when spelling NONWORDS (see Table 50). Also, the more skilled readers spelled significantly more REGULAR words, IRREGULAR words, AMBIGUOUS words, and NONWORDS correctly than the less skilled readers. When the less skilled and the more skilled readers were combined, a high correlation was found between the ability to read NONWORDS correctly and scores obtained on the LACT.

Table 50. Comparison of Spelling Strategies Used by Less Skilled and More Skilled Readers for the Four Word Types

	Logographic	Logophonic	Semi-alphabetic	Alphabetic
Regular Words	LS > MS*	LS > MS	LS > MS*	LS < MS
Irregular Words	LS > MS*	LS > MS	LS > MS	LS < MS
Ambiguous Words	LS > MS*	LS > MS	LS > MS*	LS < MS
Nonwords	LS > MS	LS > MS	LS > MS*	LS < MS*

LS = Less Skilled
MS = More Skilled
* Significant at $p \leq .01$

DISCUSSION

Research regarding the development of literacy has focused on two strategies, a visual strategy and a phonological strategy, and the extent to which children use these strategies during the process of literacy acquisition. Frith (1985) has proposed a theoretical model of literacy acquisition to account for the development of these two strategies. During the initial logographic stage, reading is based on salient visual features of words. Only familiar words can be read and spelling attempts are minimal. At this stage, children are generally insensitive to word order and grapheme-phoneme correspondences. The next stage, the alphabetic stage, is marked by the acquisition of grapheme-phoneme and phoneme-grapheme correspondence rules. The transition into the alphabetic stage theoretically occurs first for spelling, and subsequently these skills are transferred to reading. At this stage new words can be tackled; however, the alphabetic reader/speller does not have a mechanism for dealing with irregular or inconsistent orthographic spelling patterns. The final transition into the orthographic stage occurs through an amalgamation of the logographic (visual) and alphabetic (phonological) stages. According to Frith, this stage is entered first for reading

and later for spelling. Reading and spelling continue to be analytic, but words are now analyzed based on orthographic patterns realized as morphologic and/or syllabic units rather than phonological correspondence rules.

Frith's model provides a developmental framework for investigating reading and spelling development in children. Roeltgen (1987) used this theoretical model to develop the Battery of Linguistic Analysis of Writing and Reading - Children's Version (BLAWR-CV) to assess reading and spelling ability in children. The BLAWR-CV was used in this study to investigate the logographic and alphabetic stages of reading and spelling development in two groups (less skilled vs more skilled) of first through fourth grade children. An additional test, the Lindamood Auditory Conceptualization Test (LACT) (Lindamood & Lindamood, 1979) was administered to determine if there is a relationship between this measure of phonological awareness and the ability to read and/or spell nonwords.

Comparisons of Reading and Spelling Strategies

Based on Frith's contention that alphabetic spelling precedes alphabetic reading, it was hypothesized that in reading, the logographic strategy would predominate in the less skilled readers (< grade 3) and the alphabetic strategy would predominate in the more skilled readers (≥ grade 3). In spelling, it was hypothesized that the alphabetic strategy would predominate in both the less skilled readers

(< grade 3) and the more skilled readers (≥ grade 3). These hypotheses were supported when the real word and the nonword data were combined, and again when the real words were separated from the nonwords.

When the real word and nonword data were combined, a comparison between reading and spelling revealed that the less skilled readers relied on logographic and logophonic strategies more often when reading than when spelling. Whereas, they used semi-alphabetic and alphabetic strategies more often when spelling. Although the less skilled readers did attempt to read some words by sounding them out, their spelling attempts reflected a greater reliance on sound-letter correspondences. The more skilled readers, on the other hand, applied an alphabetic strategy predominately in both reading and spelling. In both groups, an alphabetic strategy was applied more frequently in spelling than in reading. These overall results support the general hypotheses and provide evidence for Frith's thesis that alphabetic spelling precedes alphabetic reading.

Combined Real Word and Nonword Reading and Spelling Patterns

A closer inspection of the combined data revealed some interesting developments in the less skilled readers' group. When just the reading data were examined, it was revealed that, although each strategy type was used by the less skilled readers to approximately the same extent, there was a slight preference for a semi-alphabetic strategy. There

was not a predominate use of the logographic strategy in this group as was suspected. These results may be accounted for in several ways. First, the logophonic strategy may play a pivotal role in the less skilled readers' reading development. It may be recalled that a logophonic response shares less than 50% of its phonemes with the target word and is always a real word. According to Snowling et al. (1986), the child may initially attempt to sound the unknown word out but rather than following this attempt through to completion, makes a guess to complete the response. Hence, this type of response could be guided either by visual or phonological analogy to another word. The key point is that this strategy reflects partial use of grapheme-phoneme correspondence rules. The logophonic strategy may only be useful for less skilled readers in reading since it is rarely used in spelling and is virtually nonexistent in the more skilled group for either reading or spelling. The use of a logophonic strategy may reflect emergence into Frith's alphabetic stage. The second point regarding these results is that seven of the twelve children in the less skilled group were reading at a second grade achievement level as measured by the WRAT-R. Of these seven children, four were reading at the end of second grade achievement level. It appears that the achievement level of this group on a whole was too high to expect a predominate use of a logographic strategy in reading. And finally, the method of reading

instruction may have influenced the results. As mentioned previously, all of the children in this study were receiving reading instruction through a combined sight-word and phonics approach. The less skilled group then had some exposure to sounding-out words as they were attempting to read them. Several studies have shown that instruction based on a phonics approach facilitates phoneme awareness (Alegria, Pignot & Morais, 1982; Read, Zhang, Nie & Ding, 1986). It is this awareness of the relationship between letters and sounds that marks the transition into Frith's alphabetic stage. Hence, the majority of the less skilled readers in this study appeared to be moving toward an alphabetic approach when reading.

In spelling, as in reading, the less skilled readers used each strategy type to some extent. However, a semi-alphabetic strategy was used much more frequently, followed closely by an alphabetic strategy. The logographic and logophonic strategies were used much less frequently, both when compared to the other spelling strategies and to the use of these strategies in reading. The preference for a sounding-out strategy is nor surprising in this group since spelling requires that letters be produced in an orderly sequence based on sound awareness and a logographic strategy is relatively insensitive to letter order as well as sound-letter correspondences. Read (1975) and others (Beers, 1980; Zutell, 1980) have documented the developmental

sequence of spelling strategies from preschoolers through second grade and have shown that children rely on one-to-one letter sound correspondences in their early spelling attempts.

Comparison of Real Word and Nonword Reading and Spelling Patterns

To investigate reading and spelling patterns further, the real words were separated from the nonwords. The two groups were compared both on the types of strategies used to read and spell real words and nonwords and on their accuracy of reading/spelling the various word types. As stated earlier, the success of using a logographic or an alphabetic strategy depends on whether the words to be read or spelled are regular words, irregular words, ambiguous words or nonwords. Either a logographic or an alphabetic strategy could be used for reading or spelling a regular word, but only a logographic strategy would be successful for irregular and ambiguous words. And, only an alphabetic strategy would be useful for reading and spelling nonwords. If the less skilled readers and the more skilled readers differ in their reliance on rules when reading and spelling as the combined data suggest, then these differences should be reflected in (1) the type of strategy used to read/spell the various word types; and (2) the accuracy with which the two groups read/spelled the different word types.

As predicted there were differences between the two groups in their reliance on rules in both reading and spelling. In reading, an inspection of the pattern of correlations for percent correct between word types for the less skilled readers revealed that the correlation between regular words and irregular words (r=.854) was higher than between irregular words and nonwords (r=.705). This finding supports the fact that the less skilled readers were accessing a visual pathway to some extent when reading words because irregular words can only be read via a visual strategy. However, in this group of less skilled readers the correlation was also high between regular words and nonwords (r=.804) suggesting an ability to apply rules when reading single words because regular words and nonwords can be read via a phonological strategy. These data suggest that the less skilled readers were using both a logographic and an alphabetic approach when reading or attempting to read single words.

The accuracy with which the less skilled readers read the various word types also lends support to this conclusion. The less skilled readers correctly read regular words (51%) better than either irregular words (33%) or nonwords (41%). If the less skilled readers were using an entirely logographic approach to read words then there should have been no difference in their ability to read regular words and irregular words. However, this was not

the case. By the same token, if the less skilled readers were primarily using an alphabetic strategy then regular words and nonwords should have been read with approximately equal ease. Again this was not the case. Based on findings from the word type data and the combined data it is concluded that the less skilled group was using both a logographic and an alphabetic strategy when reading single words. These findings are consistent with previous research which suggests that both visual and phonological strategies play a role in reading for less skilled readers (Barron, 1980; Baron & Treiman, 1980; Treiman, 1984).

Overall, the more skilled readers were using spelling-sound rules in their reading attempts significantly more often than the less skilled readers. The more skilled readers used an alphabetic strategy significantly more often when reading irregular words and nonwords than the less skilled readers. The more skilled readers' reliance on an alphabetic strategy was reflected in their increased regularizations of irregular words (e.g., kamreɪd/comrade; ɛndʒaɪn/engine) and their ability to read nonwords with 86% accuracy as compared to 41% accuracy in the less skilled group. Also, Baron and Treiman (1980) have stated that "children who relied heavily on rules tended to be better at reading regular words." (p. 177). This was true in this study as the more skilled readers read regular words with

accuracy. Unlike the less skilled readers, when the more skilled readers were confronted with a regular word not in their sight-word vocabulary they were able to rely on a sounding-out strategy to successfully read the regular word. Based on these findings, it can be concluded that the more skilled readers in this study have a stronger knowledge of spelling-sound correspondences than the less skilled readers. This finding is consistent with previous research which has shown that there is a developmental shift in children's knowledge of spelling-sound rules; that is, with increasing age and ability children acquire increasing knowledge of spelling-sound correspondences (Backman, Bruck, Hebert, Seidenberg, 1984' Snowling, 1980; Waters, Bruck & Seidenberg, 1985).

In spelling, the pattern of results was similar to that found in reading. That is, the more skilled readers were more effective and efficient in their use of an alphabetic strategy then the less skilled readers. For all the word types, the more skilled readers exhibited significantly fewer spelling errors than the less skilled readers. The more skilled readers spelled nonwords (80% accuracy) best followed by regular words (63% accuracy), ambiguous words (56% accuracy), and irregular words (42% accuracy). Whereas, the less skilled readers spelled nonwords (46% accuracy) most easily followed by ambiguous words (42%

accuracy), regular words (35% accuracy), and irregular words (19% accuracy).

An interesting finding was that the less skilled readers, unlike the more skilled readers, were able to spell ambiguous words more easily than the regular words. One possible explanation is that the ambiguous words which were presented to the less skilled readers were on a whole easier than the regular words. The ambiguous words were probably more familiar to the less skilled readers since the ambiguous word lists began at a reading age of 6 - 6 1/2 years while the regular word lists began at a reading age of 7 - 7 1/2 years. Also, almost without exception, the correct ambiguous words were of low ambiguity (i.e., only one acceptable spelling pattern; for example, man, did, dad, like). Therefore, the less skilled readers were able to spell many of the ambiguous words presented to them by applying either a visual, logographic strategy or an alphabetic strategy. In contrast, many of the ambiguous words presented to the more skilled readers were of medium to high ambiguity (e.g., phantom, brain, gaiety, speech). Therefore, if the ambiguous word was not in their sight-word vocabulary, they were unable to reply on sound-spelling rules to correctly spell the word. Although the less skilled readers were relying on sound-spelling rules, the fact that they had a significantly higher proportion of errors on regular words and nonwords suggests that, on the

whole, they had less knowledge of sound-spelling correspondences than the more skilled readers. This finding is consistent with previous research investigating sound-spelling knowledge in readers with varying reading and spelling ability (Bruck & Waters, 1988; Waters, Bruck & Seidenberg, 1985).

Although the less skilled readers were not using an alphabetic strategy to the same extent as the more skilled readers, the less skilled readers were using an alphabetic strategy more effectively in spelling than in reading. This can first be seen in their ability to spell (46%) nonwords better than they can read (41%) them. In addition, the less skilled readers regularized irregular words frequently when spelling (36%) than when reading (8%). Further, a visual inspection of the less skilled readers individual data revealed that they spelled 69 nonwords that they could not read while they only read 43 nonwords that they could not spell. This finding is consistent with Bryant and Bradley's (1980) study which demonstrated that children initially learn to read and spell in different ways. Bryant & Bradley found that young children tend to rely on visual chunks when reading but in spelling they rely primarily on sound-spelling correspondences. Although the less skilled readers in this study did apply spelling-sound rules when reading they relied on an alphabetic strategy predominately in spelling. This finding again supports Frith's contention that alphabetic spelling precedes alphabetic reading.

In summary, the results of this study indicated that both the less skilled and the more skilled readers relied on logographic and alphabetic strategies when reading and spelling words. The difference between the groups was in the extent to which they relied on each of these strategies. In reading, the less skilled readers relied more heavily on a logographic strategy whereas the more skilled readers relied primarily on an alphabetic strategy. In contrast, in spelling, both groups relied on an alphabetic strategy but the more skilled readers were more successful in applying this strategy. As expected, in both reading and spelling, the more skilled readers used an alphabetic strategy more effectively and efficiently than the less skilled readers.

Phonological Awareness and Nonword Reading and Spelling

Bradley and Bryant (1985) and others (Cataldo & Ellis, 1988; Treiman & Baron, 1981; Sawyer, 1988) have found that children's phonological awareness affects their success in reading and spelling. Specifically, segmental analysis appears to be related to the ability to use phonological correspondence rules. Based on these studies, it was predicted that there would be a higher positive correlation between the subject's ability to correctly read and spell nonwords and scores obtained on the LACT.

In both reading and spelling when the two groups were combined, there was a significant moderate positive correlation between the ability to read/spell nonwords and

scores obtained on the LACT with the spelling correlation (r=.765) higher than reading (r=.693). There was a low correlation between LACT scores and nonword reading ability for both the less skilled and the more skilled readers. The correlation also was low between LACT scores and nonword spelling for the less skilled readers. However, there was a significant moderate correlation between LACT scores and nonword spelling for the more skilled readers.

It is difficult to interpret these correlations in terms of a predictive relationship for nonword reading and spelling ability. There are at least two possibilities. One is that children who do well on the LACT will read/spell nonwords more accurately. Or alternately, children who read/spell nonwords accurately will score higher on the LACT. A visual inspection of the individual subjects' data revealed interesting information. In reading, the LACT scores of the less skilled readers revealed that each was reading below a Grade 3 level. Yet half of the subjects were reading nonwords with 50% accuracy or better. Even the subject with the lowest LACT score (27) was reading nonwords with 65% accuracy. A comparison of two sets of children with the same LACT scores revealed similar discrepancies. Two children with LACT scores of 57 read nonwords with 37% and 80% accuracy respectively. Similarly, two children with LACT scores of 100 (the highest possible score) read words with 77% and 93% accuracy respectively. Similar results

were found in spelling. The subject with the lowest LACT score (27) was spelling nonwords with 66% accuracy. For the two subjects whose LACT scores were 57, their nonword spelling accuracy was 38% and 67% respectively. However, the two subjects with LACT scores of 100 both spelled with 92% accuracy. The individual subject data reveals that the LACT is nor predictive of nonword reading/spelling ability nor is nonword reading/spelling ability predictive of LACT scores.

There are several reasons why the relationship between LACT scores and the ability to read/spell nonwords was not clear. First, the total test score on the LACT combines scores on Categories I and II although the two parts are measuring different phonological abilities. In Category I, the subject must manipulate colored blocks to discriminate how many sounds he heard, whether the sounds were the same or different, and the order of the sounds. In Category II, the subject must manipulate colored blocks to represent changes which occur in spoken syllable patterns as single sounds are added, substituted, omitted, shifted or repeated. Clearly, the requirements of Category II tasks are much more complex phonologically. In addition, it is possible that the LACT may not be measuring the phonological abilities necessary for learning phonological correspondence rules. Baron and Treiman (1980) have stated that "if what is required to learn an alphabet is the ability to represent

spoken words in terms of phonemes, this ability might be most clearly reflected in the ability to imitate nonsense words" (p. 187).

Finally, when using simultaneous correlations there is always the problem of the unknown factor. According to Goswami and Bryant (1990), "both measures might be affected by some other unknown, and therefore unmeasured, third factor, and thus, that despite a positive correlation there may be no connection between the two" (pp. 96-97). In this study there were no controls over such variables as intelligence, verbal knowledge or social background, each of which could affect a child's knowledge of spelling-sound relationships and the ability to read and spell.

Methodological Issues

This study was designed to investigate the use of logographic and alphabetic strategies in less skilled and more skilled readers when reading and spelling single real words and nonwords. Several factors need to be considered which may have affected the outcome of this investigation. Traditionally, as in the current study, investigations of reading and spelling ability in children have assigned subjects to groups based on reading scores. However, an alternate method might be to classify children based on spelling achievement. A comparison of the groupings based on WRAT-R spelling scores revealed that regardless of whether a reading score or a spelling score was used in this

study, the subjects would have been classified into the same group.

Another factor related to subject classification centers on the variability of reading achievement levels within the two groups. In this study, there was wide variability in the reading levels within each of the groups. The less skilled readers were reading below Grade 3 as measured by the WRAT-R with reading achievement levels of ranging from the beginning of Grade 1 to the end of Grade 2. It is entirely possible that the overall reading achievement level for this group was too high to predict a primary use of logographic strategy. Similarly, the more skilled readers were reading equal to or above Grade 3 achievement with scores ranging from the beginning of third grade to the beginning of six grade. In order to fully investigate the developmental changes in reading and spelling strategies, it appears to be necessary to divide groups into smaller grade level increments (e.g., beginning of first grade, end of first grade, etc.). In this manner, in reading, it would be possible to identify when children are relying on a logographic strategy and when an alphabetic strategy begins to become effective and efficient. In spelling, it would be possible to identify more subtle developmental changes in the acquisition and use of an alphabetic strategy. For example, in this study the logophonic strategy appeared to play an important role in reading for the less skilled

readers. The use of this strategy may identify those children in transition from a logographic state to an alphabetic stage in reading.

Finally, since the subjects were grouped into less skilled and more skilled readers in this study, individual differences were not taken into account. Baron (1979) and Treiman (1984) have found that some children prefer to use a visual strategy while others prefer a phonological strategy when reading and spelling single words. The design of this study masked many individual differences relating to a Chinese-Phoenician continuum.

Conclusions and Clinical Implications

In the initial stage of literacy, children read and spell in different ways, relying on a visual strategy in reading and a phonological strategy in spelling. With time, experience in reading has an influence on spelling, and knowledge gleaned from spelling has an effect on reading. The interactive relationship between reading and spelling strategies is reflected in skilled readers use of both visual and phonological strategies when reading and spelling.

Frith's (1985) three stage model of literacy acquisition accounts for the interactive development of reading and spelling and the development of logographic and alphabetic strategies in both reading and spelling. Accordingly, at one stage reading leads the transition into

the next stage, while at another stage spelling is the pacemaker. This study provided support for Frith's contention that an alphabetic strategy is first utilized in spelling and later transferred to reading which was previously accomplished through a logographic strategy. For the normal subjects in this study, the ability to use grapheme-phoneme correspondence rules in reading increased with reading age. Indeed, the knowledge and use of spelling-sound correspondences increased with reading age in both reading and spelling. More skilled readers were able to rely on an alphabetic strategy when confronting an unfamiliar word whether reading or spelling.

The utility of the BLAWR-CV in identifying reading and spelling strategies used by normal less skilled and more skilled readers has been documented in this study. There are several features of the BLAWR-CV which make it a clinically worthwhile tool. First, the word lists for each of the subtests are arranged hierarchically according to grade level reading and spelling achievement as measured by the Wide Range Achievement Test - Revised (WRAT-R) (Jastak & Wilkinson, 1984). This allows the presentation of words that are appropriate to the child's reading and spelling ability which in turn allows an error analysis of the child's typical error patterns. Secondly, the subtests of the BLAWR-CV are comprised of nonwords and words with regular and homographic spelling patterns. It was

demonstrated in this study that the knowledge and use of logographic and alphabetic strategies canbe assessed when the child is confronted with reading/spelling various types of words. In addition, the strategy which a child uses to read words of various types differentiates less skilled from more skilled readers. Finally, the theoretical framework of the BLAWR-CV is based on Frith's developmental model of literacy acquisition. The BLAWR-CV would be useful in a clinical setting not only to document the approach which normal subjects take to read and spell words but also to investigate reading and spelling patterns in dyslexic subjects.

Although the BLAWR-CV is an effective clinical tool, there are several drawbacks to consider. A major drawback is the lack of an explicit error classification system to code the reading and spelling errors. This study has provided a classification scheme which was not only easy to use but also reliable in identifying strategies used to read and spell real words and nonwords. Another drawback is the length of time it takes to administer the BLAWR-CV. Even though the entire test was not used in this study it took approximately two hours to administer both the reading and spelling subtests. If the list of words on each subtest were shortened systematically it would become an efficient as well as an effective measure of children's reading and spelling abilities.

Children's phonological awareness affects their success in reading and spelling. Specifically, phonological segmental analysis ability appears to be related to the ability to use spelling-sound correspondence rules. A measure of phonological awareness which incorporates phoneme segmentation, the Lindamood Auditory Conceptualization Test (LACT) (Lindamood & Lindamood,1971), was used in this study to determine the relationship between LACT scores and the ability to correctly read and spell nonwords. For this group of subjects the LACT was not predictive of nonword reading and spelling ability. This finding suggests that the LACT should not be used as the sole measure of children's alphabetic skills. In a clinical setting, it may be more useful to have a child read and spell nonwords in order to assess their alphabetic abilities.

The results of this study have implications for reading and spelling instruction. Since both logographic and alphabetic strategies play important roles in beginning reading and spelling emphasis on a sight-word approach or on a phonics approach alone may influence a child to focus on one strategy at the expense of another. In addition, some children may have difficulty segmenting the sounds which make up words therefore making it difficult to learn to read through a phonics approach. Children also should be encouraged to write freely on a regular basis. Awareness of

a child's creative spelling attempts will allow a teacher to adjust reading and spelling instruction to an individual child's needs.

Subject	Chronological Age	Sex	Grade	WRAT-R Raw Score	WRAT-R Grade Level	LACT Total Score	LACT Grade Level
C.C.	6 - 7	M	1	Reading 36 Spelling 20	1M Pre-1st	48	1st half of 1st
J.C.	7 - 3	M	1	Reading 49 Spelling 32	2B 2B	27	Below Kdg
N.S.	6 - 6	M	1	Reading 32 Spelling 25	1B 1M	43	1st half of 1st
N.S.	6 - 3	F	1	Reading 38 Spelling 25	1M 1M	29	Below Kdg
T.D.	7 - 0	F	1	Reading 30 Spelling 22	1B 1B	39	2nd half of Kdg
E.S.	6 - 5	F	1	Reading 51 Spelling 31	2M 2B	73	1st half of 3rd
H.B.	6 - 5	F	1	Reading 35 Spelling 22	1B 1B	38	2nd half of Kdg
Q.M.	7 - 8	M	2	Reading 51 Spelling 34	2M 2M	40	2nd half of Kdg
C.R.	7 - 5	M	2	Reading 65 Spelling 39	3E 3B	100	7th-Adult

Subject	Chronological Age	Sex	Grade	WRAT-R Raw Score	WRAT-R Grade Level	LACT Total Score	LACT Grade Level
B.S.	8 - 7	F	2	Reading 60 Spelling 38	3B 3B	57	2nd half of 1st
R.L.	8 - 1	F	2	Reading 56 Spelling 33	2E 2M	57	2nd half of 1st
M.M.	8 - 2	F	2	Reading 55 Spelling 36	2E 2E	34	1st half of Kdg
C.C.	8 - 3	F	3	Reading 67 Spelling 43	4B 4E	82	1st half of 4th
M.H.	9 - 4	F	3	Reading 67 Spelling 44	4B 4E	79	2nd half of 3rd
J.S.	8 - 8	F	3	Reading 66 Spelling 42	3E 4B	82	1st half of 4th
S.V.	8 - 7	F	3	Reading 67 Spelling 42	4B 4B	87	1st half of 5th
J.C.	10 - 7	M	4	Reading 57 Spelling 37	2E 2E	70	2nd half of 2nd
M.S.	10 - 7	M	4	Reading 73 Spelling 42	5B 4B	87	1st half of 5th

Subject	Chronological Age	Sex	Grade	WRAT-R Raw Score	WRAT-R Grade Level	LACT Total Score	LACT Grade Level
Y.H.	10 - 0	M	4	Reading 69 Spelling 44	4E 4E	59	2nd half of 1st
L.M.	9 - 6	M	4	Reading 68 Spelling 41	4E 3E	82	1st half of 4th
C.S.	8 - 10	F	4	Reading 67 Spelling 41	4B 3E	100	7th-Adult
S.J.	10 - 1	F	4	Reading 55 Spelling 36	2E 2E	63	1st half of 2nd
R.W.	10 - 4	F	4	Reading 76 Spelling 45	6B 5B	63	1st half of 2nd
J.S.	9 - 8	F	4	Reading 74 Spelling 45	5E 5B	75	1st half of 3rd

APPENDIX B
PARENT CONSENT FORM

Date:_____

Dear_____:

I am the speech/language clinician at Kimball Wiles Elementary as well as a graduate student in the Department of Speech at the University of Florida. I am studying reading and spelling development in young children for my dissertation. I hope this study will provide me with information that will be useful in the future for identifying and helping children with reading and/or spelling problems. I would like for your child to participate in this study.

If your child participates, I will be giving your child a vision and hearing test and some reading and spelling tests. These tests will require your child to perform several different reading and spelling tasks. The testing will take approximately one hour to complete. Your child will be allowed to make up any missed classroom work. Your signature on this form represents your permission for your child to participate and to allow the information to be utilized in a research study. If your child's performance on the reading and spelling tasks is discussed in any papers or presentations, your child will remain totally anonymous.

Participation or non-participation in this study will not effect your child's grades and there will be no monetary compensation. I do not anticipate any risks to your child as a result of participation in this study. Your child is free to withdraw from this project at any time. If you have any questions before, after or during this project, please feel free to contact me, Jamie Stapell, at 372-7058 (Wiles) or 332-0612 (home).

I have read and understand the procedure described above. I agree to allow my child, _____ to participate in this project and I have a copy of this description.

_____		_____	
Parent	Date	Second Parent	Date
_____		_____	
Supervisor	Date	Principal Investigator	Date

APPENDIX C
LEVELS FOR BEGINNING THE BLAWR-CV AND BLAWR-AV BASED ON WRAT-R READING AND SPELLING GRADE LEVELS

READING

WRAT Grade Level	Regular/Irregular Word List
1B	CV - 1
1M	CV - 1
1E	CV - 2
2B	CV - 2
2M	CV - 4
2E	CV - 6
3B	AV - 1
3E	AV - 2
4B+	AV - 3

SPELLING

WRAT Grade Level	Regular/Irregular Word List	Ambiguous Word List
1B, 1M,	CV - 1	CV - 1
1E	CV - 1	CV - 2
2B	CV - 2	CV - 3
2M	CV - 3	CV - 4
2E	CV - 4	AV - 1
3B	CV - 5	AV - 1
3E, 4B	CV - 6	AV - 1
4E	AV - 1	AV - 1
5B	AV - 1	AV - 2
5E	AV - 2	AV - 2
6B+	AV - 3	AV - 2

APPENDIX D
EXEMPLARS OF ACCEPTABLE VOWEL AND CONSONANT PRODUCTIONS

a	- /eɪ/	table	ou	- /aʊ/	around
a	- /æ/	fat	ou	- /ʊ/	should
a	- /ɔ/	walk	ou	- /ɔ/	thought
a	- /a/	watch	ou	- /u/	cougar
a	- /ə/	again	ou	- /ʌ/	couple
a	- /ɛ/	anything			
a	- /ɪ/	hostage	ow	- /o/	low
a	- /aɪ/	garage	ow	- /aʊ/	cow
e	- /i/	electric	au	- /ɔ/	caught
e	- /ɛ/	reputation	aw	- /ɔ/	saw
e	- /ɪ/	engage	ay	- /eɪ/	day
e	- /ʌ/	umbrella	ew	- /ju/	few
			ey	- /eɪ/	they
i	- /ɪ/	bridge	oa	- /o/	boat
i	- /aɪ/	pint	oo	- /ʊ/	book
			oo	- /u/	moon
o	- /ɔ/	coffee	oi	- /ɔɪ/	soil
o	- /o/	dope	oy	- /ɔɪ/	boy
o	- /a/	on	ui	- /ɪ/	build
o	- /u/	move			
o	- /ʌ/	money	ar	- /ɛɚ/	marriage
			er	- /ɚ/	rooster
u	- /ʌ/	bud	ir	- /ɝ/	circuit
u	- /ʊ/	sugar	or	- /ɚ/	tractor
u	- /ju/	beautiful	ur	- /ɝ/	fur
u	- /u/	magnitude			
			c	- /s/	city
ea	- /i/	teacher	c	- /k/	cat
ea	- /ɛ/	ready	c	- /ʃ/	ocean
ea	- /eɪ/	great	g	- /g/	gum
			g	- /dʒ/	gym
ie	- /ɛ/	friend			
ie	- /i/	field	ch	- /ʃ/	chute
ie	- /ɪ/	mischief	ch	- /k/	choral
			ch	- /tʃ/	church
ei	- /eɪ/	reindeer	gh	- /f/	cough
ei	- /ə/	sovereign	ph	- /f/	graph
ei	- /i/	either	ck	- /k/	tick
ai	- /ɪ/	again			
ai	- /ɛ/	said			
ai	- /eɪ/	straight			

REFERENCES

Alegria, J., Pignor, E., & Morais, J. (1982). Phonetic analysis of speech and memory codes in beginning readers. Memory and Cognition, 10, 451-456.

Backman, J., Bruck, M., Hebert, M., & Seidenberg, M. (1984). Acquisition and use of spelling-sound correspondence in reading. Journal of Experimental Child Psychology, 38, 114-133.

Baron, J. (1979). Orthographic and word-specific mechanisms in children's reading of words. Child Development, 50, 60-72.

Baron, J., & Treiman, R. (1980). Use of orthography in reading and learning to read. In J.F. Kavanagh & R.L. Venezky (Eds.), Orthography, reading and dyslexia (pp. 171-189). Baltimore: University Park Press.

Baron, J., Treiman, R., Wilf, J.F., & Kellman, P. (1980). Spelling and reading by rules in U. Frith (Ed.), Cognitive processes in spelling (pp. 159-194). New York: Academic Press.

Baron, R.W. (1980). Visual and phonological strategies in reading and spelling. In U. Frith (Ed.), Cognitive processes in spelling (pp. 195-213). New York: Acedemic Press.

Beers, J.W. (1980). Developmental strategies of spelling competence in primary school children. In E. H. Henderson & J. W. Beers (Eds.), Developmental and cognitive aspects of learning to spell. Newark, DE: International Reading Association.

Blachman, B.A. (1989). Phonological awareness and word recognition. In A.G. Kamhi & H.W. Catts (Eds.), Reading disabilities: A developmental language perspective (pp. 133-158). Boston: College Hill Press.

Bradley, L., & Bryant, P.E. (1978). Difficulties in auditory organization as a possible cause of reading backwardness. Nature, 271, 746-747.

Bradley, L., & Bryant, P.E. (1979). Independence of reading and spelling in backward and normal readers. Developmental Medicine and Child Neurology, 21, 504-514.

Bradley, L., & Bryant, P.E. (1985). Rhyme and reason in reading and spelling. Ann Arbor: University of Michigan Press.

Bruck, M. (1988). The word recognition and spelling of dyslexic children. Reading Research Quarterly, 23(1), 51-69.

Bruck, M., & Waters, G. (1988). An analysis of the spelling errors of children who differ in their reading and spelling skills. Applied Psycholinguistics, 9, 77-92.

Bryant, P.E., & Bradley, L. (1980). Why children sometimes write words which they do not read. In U. Frith (Ed.), Cognitive processes in spelling (pp. 355-370). New York: Academic Press.

Bryant, P., & Bradley, L. (1985). Children's reading problems. New York: Basil Blackwell.

Cataldo, S., & Ellis, N. (1988). Interactions in the development of spelling, reading and phonological skills. Journal of Research in Reading, 11(2), 86-109.

Catts, H.W. (1988). Phonological processing deficits and reading disabilities. In A.G. Kamhi & H.W. Catts (Eds.), Reading disabilities: A developmental language perspective (pp. 101-132). Boston: College Hill Press.

Chall, J. (1983). Stages of reading development. New York: McGraw-Hill.

Coltheart, M., Davelaar, E., Jonasson, J.T., & Besner, D. (1977). Access to the internal lexicon. In S. Dornic (Ed.), Attention and performance (pp. 157-163). New York: Academic Press.

Cromer, R.F., (1980). Spontaneous spelling by language-disordered children. In U. Frith (Ed.), Cognitive processes in spelling (pp. 405-421). New York: Academic Press.

Ehri, L. (1987). Learning to read and spell words. Journal of Reading Behavior, 19(1), pp. 5-31.

Ehri, L. (1991). The development of reading and spelling in children: An overview. In M. Snowling & M. Thomson (Eds.), Dyslexia: Integrating theory and practice (pp. 63-79). San Diego: Singular Publishing Group Inc.

Ellis, N. (1991). Spelling and sound in learning to read. In M. Snowling & M. Thomson (Eds.), Dyslexia: Integrating theory and practice (pp. 80-94). San Diego: Singular Publishing Group Inc.

Fox, B., & Routh, D.K. (1975). Analyzing spoken language into words, syllables and phonemes: A developmental study. Journal of Psycholinguistic Research, 4, 331-342.

Frith, U. (1979). Reading by eye and writing by ear. In P.A. Kolers, M. Wrolstad, & H. Bouma (Eds.), Processing of visible language (pp. 379-390). New York: Plenum Press.

Frith, U. (1980). Unexpected spelling problems. In U. Frith (Ed.), Cognitive processes in spelling (pp. 495-515). New York: Academic Press.

Frith, U. (1983). The similarities and differences between reading and spelling problems. In M. Rutter (Ed.), Developmental neuropsychiatry (pp. 453-472). New York: Guilford Press.

Frith, U. (1985). Beneath the surface of developmental dyslexia. In K.E. Patterson, J.C. Marshall & M. Coltheart (Eds.), Surface dyslexia (pp. 301-329). London: Routledge and Kegan Paul.

Goswami, U. (1991). Recent work on reading and spelling development. In M. Snowling & M. Thomson (Eds.), Dyslexia: Integrating theory and practice (pp. 108-121). San Diego: Singular Publishing Group Inc.

Goswami, U., & Bryant, P. (1990). Phonological skills and learning to read. Hillsdale, NJ.: Lawrence Erlbaum Associates Inc.

Gould, S.M. (1976). Spelling isn't reading backwards. Journal of Reading, 20, 220-225.

Holmes, D.L., & Peper, R.L. (1977). An evaluation of the use of spelling error analysis in the diagnosis of reading disabilities. Child Development, 48, 1708-1711.

Horn, E. (1926). A basic writing vocabulary. (University of Iowa Monograph in Education No. 4). Iowa City: University of Iowa Press.

Jastak, S., & Wilkinson, G.S. (1984). Wide Range Achievement Test - Revised. Wilmington, DE: Jastak Associates.

Jorm, A., & Share, D. (1983). Phonological recoding and reading acquisition. Applied Psycholinguistics, 4, 103-147.

Kamhi, A.G., & Catts, H.W. (1989). Language and reading: Convergence, divergence and development. In A.G. Kamhi & H.W. Catts (Eds.). Reading disabilities: A developmental language perspective (pp. 1-34). Boston: College Hill Press.

Lindamood, C., & Lindamood, P. (1971). Lindamood Auditory Conceptualization Test. Boston, MA: Teaching Resources.

Marcel, T. (1980). Phonological awareness and phonological representation: Investigation of a specific spelling problem. In U. Frith (Ed.), Cognitive processes in spelling. London: Academic Press.

Marsh, G., & Desberg, P. (1983). The development of strategies in the acquisition of symbolic skills. In D.A. Rogers & J. A. Sloboda (Eds.), The acquisition of symbolic skills (pp. 149-154). New York: Plenum Press.

Marsh, G., Desberg, P., & Cooper, J. (1977). Developmental changes in reading strategies. Journal of Reading Behavior, 9, 391-394.

Marsh, G., Friedman, M., Welch, V., & Desberg, P. (1980). The development of strategies in spelling. In U. Frith (Ed.), Cognitive processes in spelling (pp. 339-354). New York: Academic Press.

Marsh, G., Friedman, M., Welch, V., & Desberg, P. (1981). A cognitive developmental theory of reading acquisition. In G.E. MacKinnon & T.G. Waller (Eds.), Reading research: Advances in theory and practice (pp. 199-221). New York: Academic Press.

Morais, J., Cary, L., Alegria, J., & Bertelson, P. (1979). Does awareness of speech as a sequence of phonemes arise spontaneously? Cognition, 7, 323-331.

Nelson, H.E. (1980). Analysis of spelling errors in normal and dyslexic children. In U. Frith (Ed.), Cognitive processes in spelling (pp. 475-493). New York: Academic Press.

Read, C. (1986). Children'creative spellings. London: Routledge and Kegan Paul.

Read, C., Zhang, Y., Nie, H., & Ding, B. (1986). The ability to manipulate speech sounds depends on knowing alphabetic writing. Cognition, 24, 31-44.

Roeltgen, D.P. (1985). Battery of Linguistic Analysis for Writing and Reading - Adult Version. Unpublished test battery. University of Missouri, Columbia.

Roeltgen, D.P. (1987). Battery of Linguistic Analysis for Writing and Reading - Children's Version. Unpublished test battery. University of Missouri, Columbia.

Sawyer, D.J. (1988). Studies of the effects of teaching auditory segmenting skills within the reading program. In R.L. Masland & M. W. Masland (Eds.), Preschool prevention of reading failure (pp. 121-142). Parkton, MD: York Press.

Seidenberg, M.S., Bruck, M., Fornarolo, G., & Backman, J. (1985). Word recognition processes of poor and disabled readers: Do they necessarily differ? Applied Psycholinguistics, 6, 161-180.

Snowling, M. (1980). The development of grapheme-phoneme correspondence in normal and dyslexic readers. Journal of Experimental Child Psychology, 29, 294-305.

Snowling, M. (1985). The assessment of reading and spelling skills. In M.J. Snowling (Ed.), Children's written language difficulties (pp. 80-95). Philadelphia: Nefer-Nelson.

Snowling, M. (1987). Dyslexia. New York: Basil Blackwell.

Snowling, M., & Frith, U. (1981). The role of sound, shape and orthographic cues in early reading. British Journal of Psychology, 72, 83-87.

Snowling, M., & Perin, D. (1982). The development of phoneme segmentation skills in young children. In J. Sloboda & D.A. Rogers (Eds.), The acquisition of symbolic skills (pp. 50-69). New York: Plenum Press.

Snowling, M., Stackhouse, J., & Rack, J. (1986). Phonological dyslexia and dysgraphia - a developmental analysis. Cognitive Neuropsychology, 3(3), 309-339.

Stackhouse, J. (1989). Relationship between spoken and written language disorders. In K. Mogford & J. Sadler (Eds.), Child language disability (pp. 33-39). Philadelphia: Multilingual Matters Ltd.

Stanovich, K. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. Reading Research Quarterly, 21, 360-407.

Treiman, R. (1984). Individual differences among children in spelling and reading styles. Journal of Experimental Child Psychology, 37, 463-477.

Treiman, R. (1985). Onsets and rimes as units of spoken syllables: Evidence from children. Journal of Experimental Child Psychology, 39, 161-181.

Treiman, R., & Baron, J. (1981). Segmental analysis ability: Development and relation to reading ability. In G.E. MacKinnon & T.G. Waller (Eds.), Reading research: Advances in theory and practice, 3, (pp. 159-197). New York: Academic Press.

Venezky, R.L. (1970). The structure of English orthography. The Hague: Mouton.

Wagner, R., & Torgensen, J. (1987). The nature of phonological processing and its causal role in the acquisition of reading skills. Psychology Bulletin, 101, 192-212.

Waters, G.S., Bruck, M., & Seidenberg, M. (1985). Do children use similar processes to read and spell words? Journal of Experimental Child Psychology, 39, 511-530.

Wijk, A. (1966). Rules of pronunciation for the English language. New York: Oxford University Press.

Zutell, J. (1980). Children's spelling strategies and their cognitive development. In E.H. Henderson & J.W. Beers (Eds.), Developmental and cognitive aspects of learning to spell. Newark, DE: International Reading Association.

BIOGRAPHICAL SKETCH

Jamie Barron Schwartz was born on May 27, 1947, in Olean, New York. She was reared in West Seneca, New York, and graduated from West Seneca Senior High School in 1965. She attended Cazenovia College, Cazenovia, New York, where she graduated magna cum laude with an Associate of Applied Arts degree in child development in June of 1967.

Ms. Schwartz has taught at the Children's Developmental Center and Liverpool Laboratory School, Syracuse, New York; Kiddie Haven Nursery School, Buffalo, New York; and, Castillo de Ninon, El Paso, Texas.

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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